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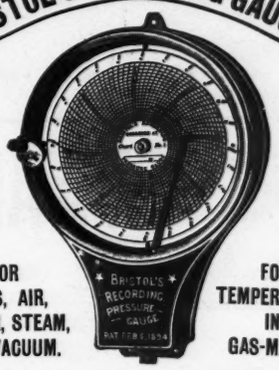

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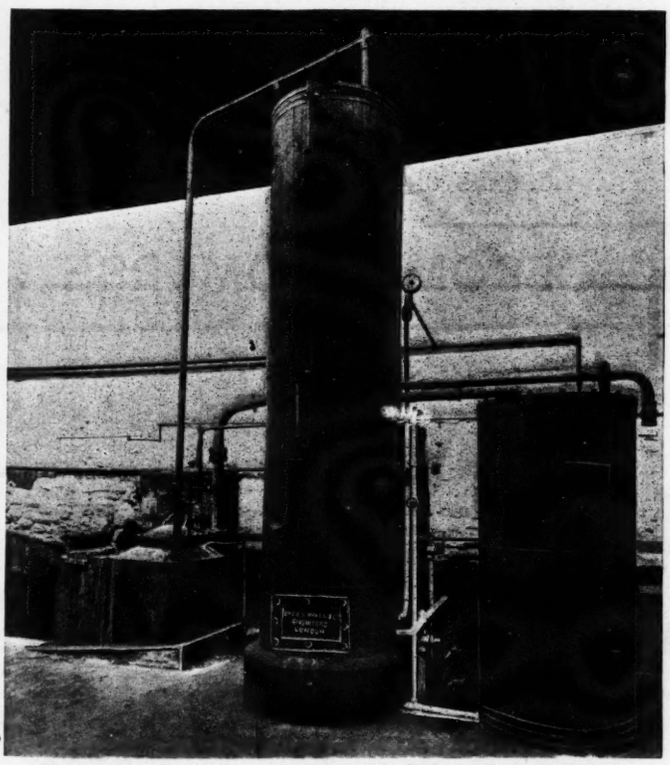

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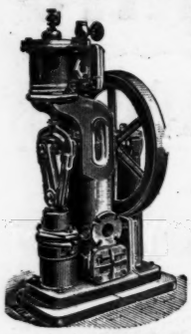

Fig. 705. "SINGLE RAM" STEAM-PUMP.

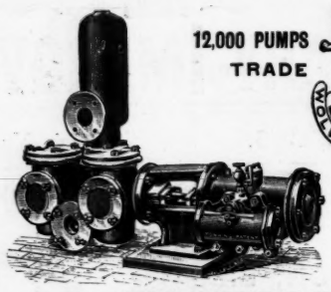

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

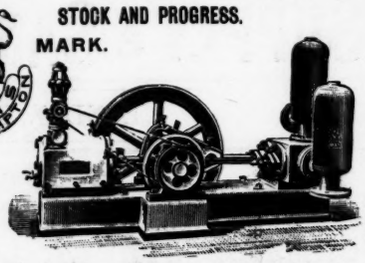

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

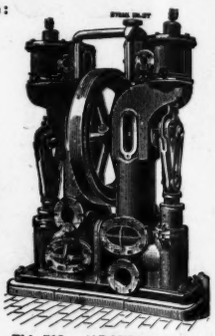

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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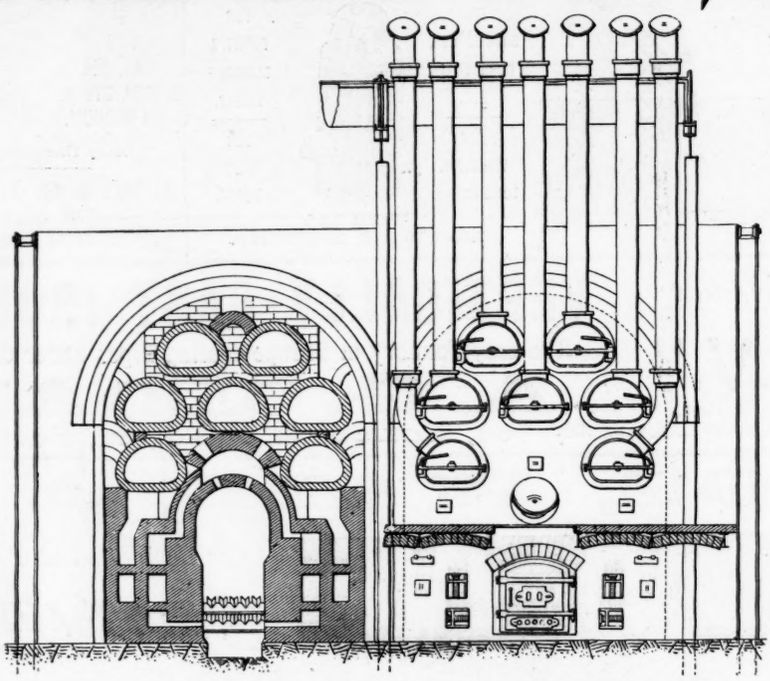

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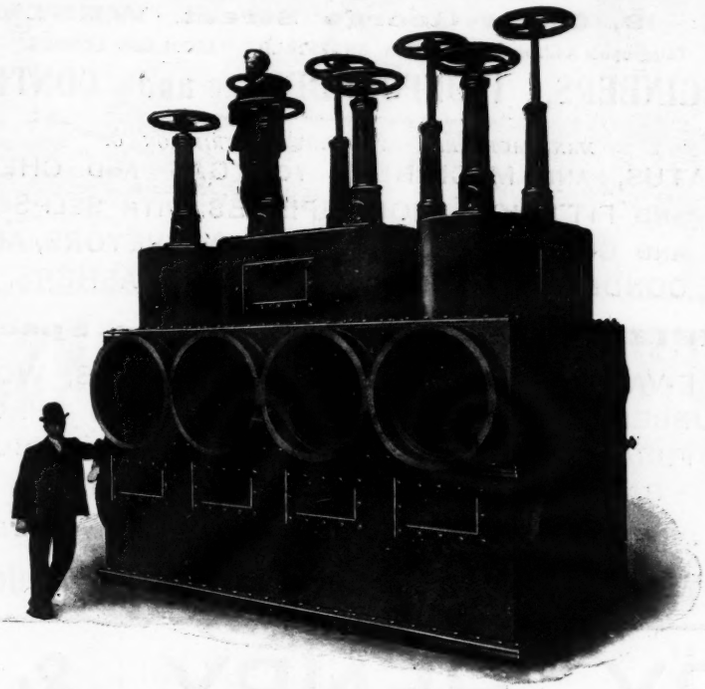

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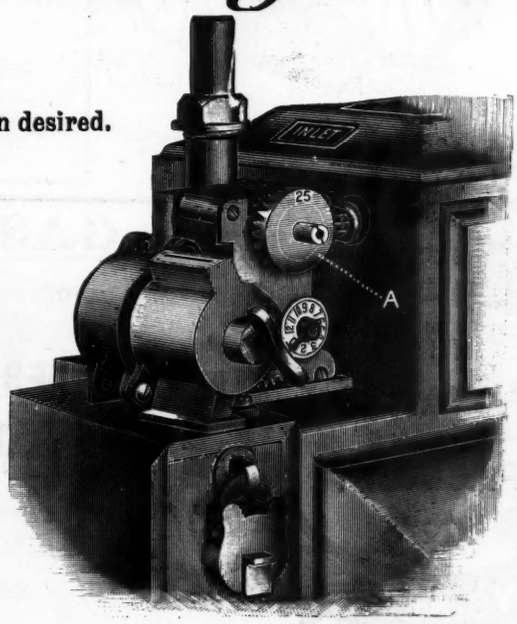

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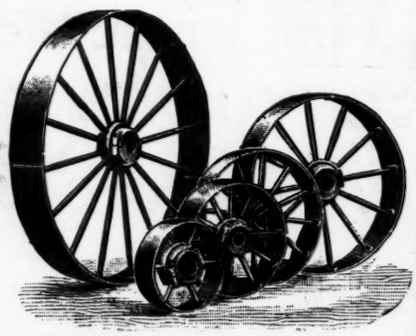

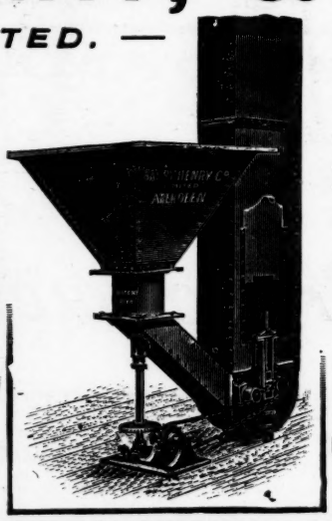

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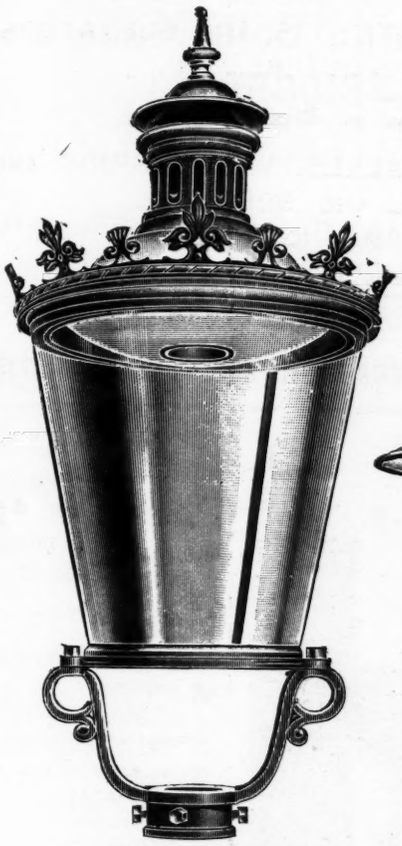
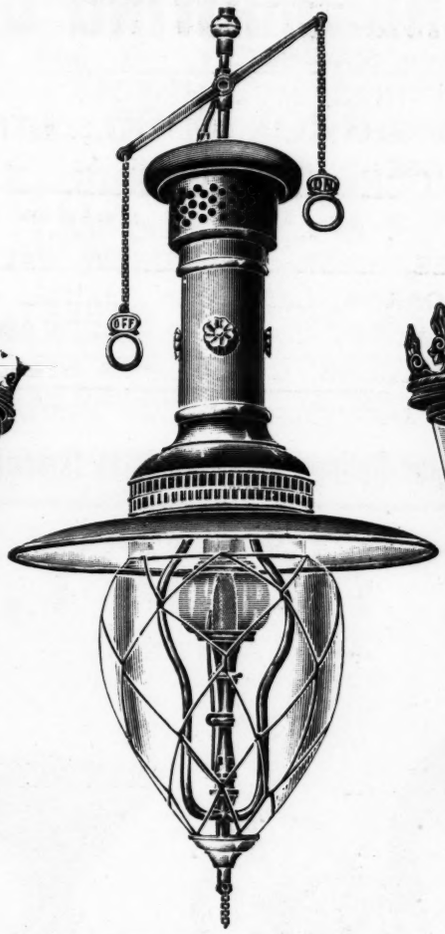


Fig. 35. 100 c.p.



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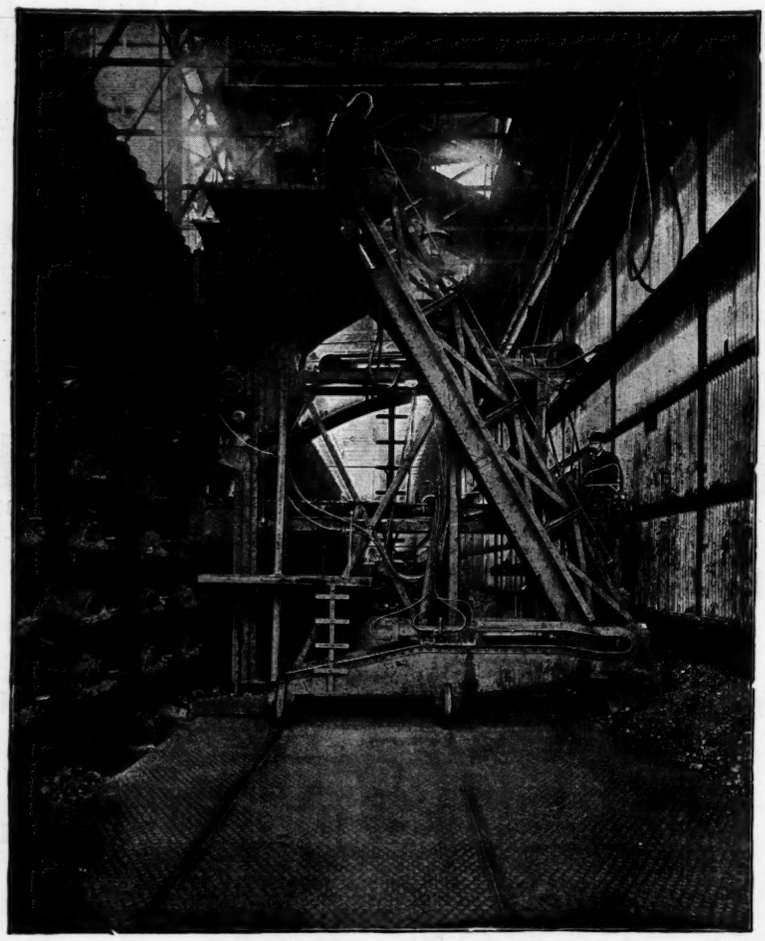

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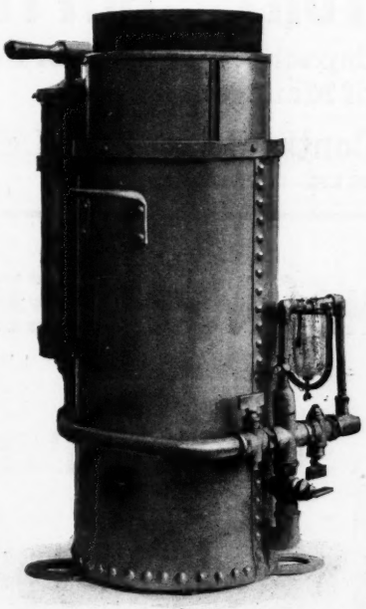

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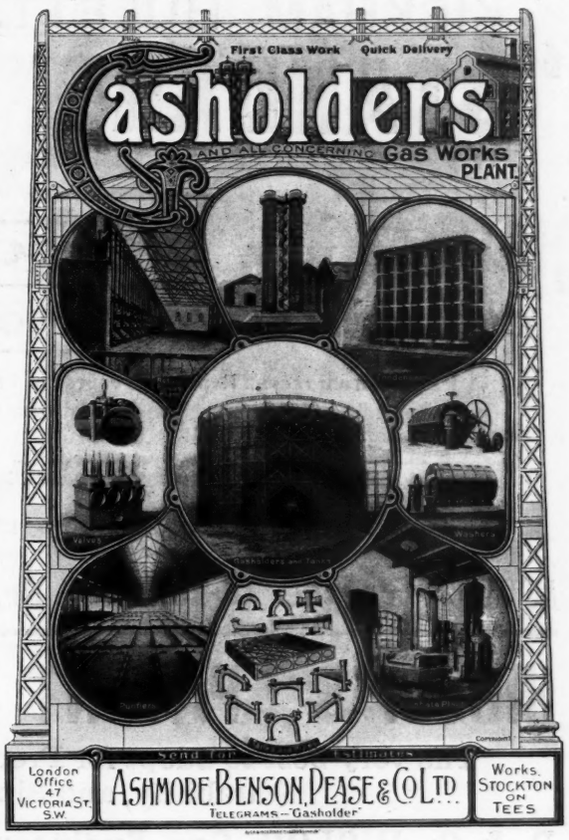

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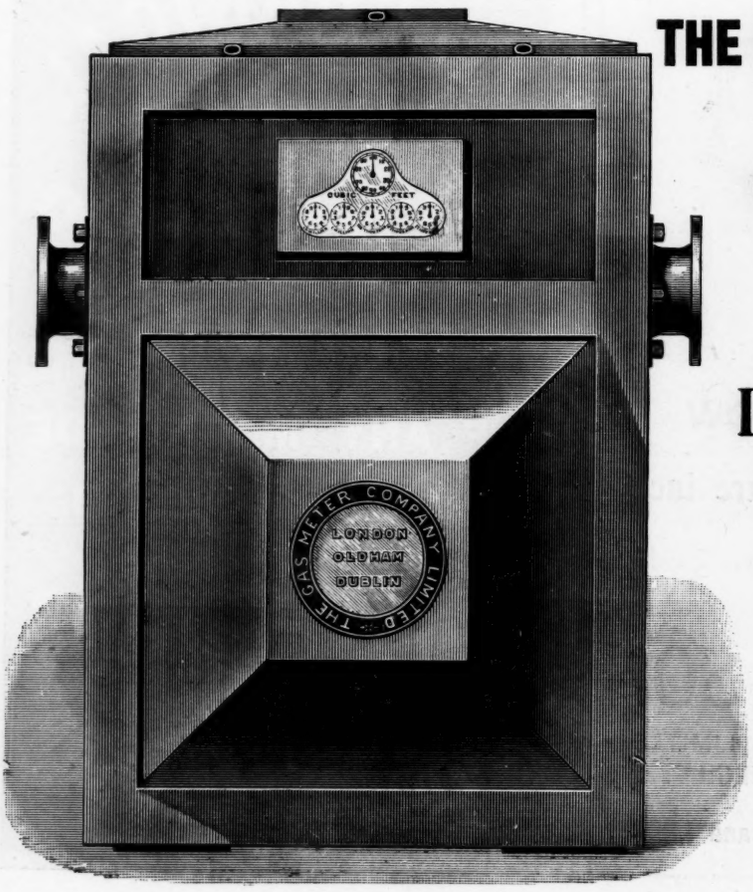

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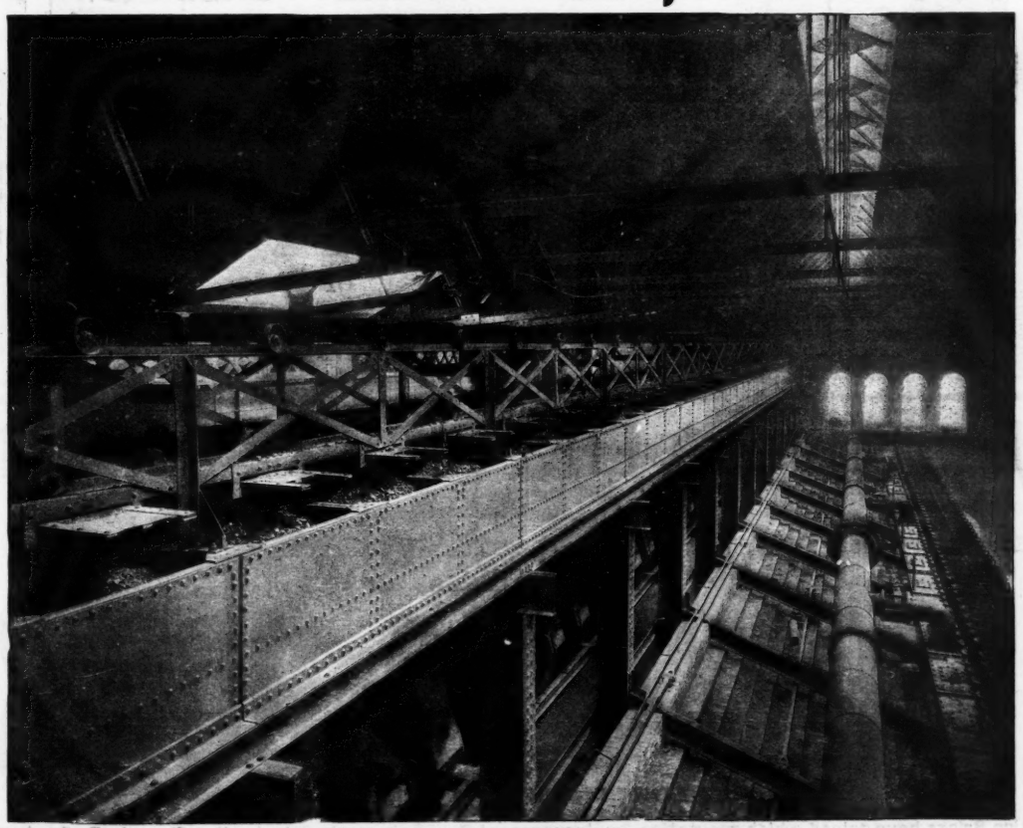

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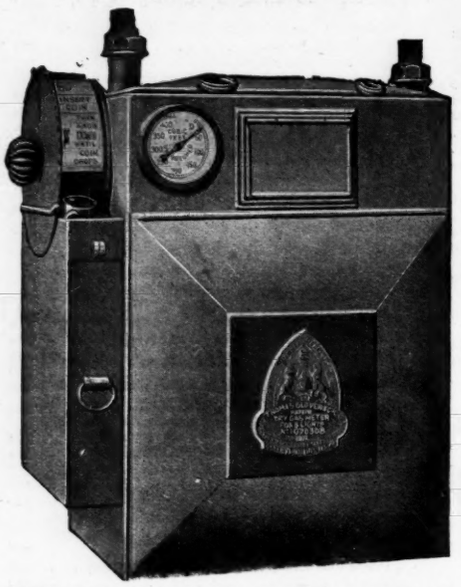

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EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT FLEET ST., LONDON.

VOL. XC., No. 2190.—TUESDAY, MAY 2, 1905.

EDITORIAL NOTES—GAS, &c.

Power Gas.

THIS subject, which is one of the highest importance to the gas industry, is much in evidence just now. Last week we published the concluding portion of a most useful communication from Mr. J. F. Bell, on "Competition for the Supply "of Power;" while this week we have—in addition to the summary of a paper on the "Production and Use of Power "Gas," read at a meeting of the Manchester Association of Engineers by Mr. Thomas Rigby, a member of the staff of Messrs. Crossley Bros., Limited—the full text of a very interesting lecture by Mr. Dugald Clerk on "Coal Gas and "Its Rivals for Motive Power," which was delivered on his behalf by his partner, Mr. M. A. Adam, B.Sc., before the North of England Gas Managers' Association on Saturday. All these authorities bear testimony, in their own way, to the great and growing importance of internal combustion engines as a substitute for steam—Mr. Dugald Clerk and Mr. Rigby from an outside standpoint, and Mr. Bell from that of one who is, above all, desirous of increasing gas consumption. Their communications are both interesting and instructive, and will be found to well repay careful study by all who aim at the advancement of the gas industry.

During the International Gas Exhibition which was held last year at Earl's Court, attention was directed, in these columns, to the enormous advantages derived by gas undertakings from the supply to gas-engines, which, in the course of a very few years, has assumed such large proportions as to greatly more than compensate for the loss of consumption which has resulted from the introduction of electric lighting. Mr. Dugald Clerk estimates that the present consumption of illuminating gas for power purposes is about 25 per cent. of the whole of such consumption. This is probably an over-estimate, since it is not reached by some of the largest gas undertakings, although exceeded —in a few cases considerably—by some of the smaller ones. Whatever be the quantity, however, it is a very considerable one, and well worth the endeavour to retain. According to Mr. Clerk, the popularity of the gas-engine was originally due, not to its intrinsic economy so much as to the extravagant fuel consumption of the steam-engines which it superseded. It must, however, be added, that the readiness with which it can be started and stopped, its cleanliness, and the avoidance of a steam-boiler, with all its attendant inconveniences, counted for much in its favour. This is apparent from the fact that the Dowson gas-producer, which was called into being with the object of reducing fuel cost to a greater extent than seemed to be possible with town gas, has never become popular in any district where the latter is available at a moderate cost. It is hardly too much to say that, whatever its utility where a public supply of gas is not available, gas undertakings have scarcely perceived the effects of its competition. The fact is, the vast majority of power users have hitherto shunned producers (town gas being available) just as they formerly discarded steam-boilers; and for practically the same reason—namely, that any moderate saving in fuel cost does not compensate for the extra trouble and inconvenience involved.

Now, however, the conditions have undergone a change. The "suction" producer not only effects a further economy of fuel, but has the additional advantages over the older form of producer of a low initial cost, great handiness, the absence of a holder, and the small amount of attention it requires. Nevertheless, it is estimated that a coal gas of (say) 600 British thermal units calorific value, supplied at 1s. 6d. per 1000 cubic feet, would run it exceedingly close—so close, in fact, that in Mr. Clerk's opinion but few small producer plants would be introduced into a town where gas was sold at this price. This opinion, be it observed, is founded upon a comparison of costs. If the superior simplicity, cleanliness, and convenience of the gas-engine operated by town gas be taken into account, it is probable that the balance of advantages would, in the mind of a consumer, be largely in its favour. It is to be hoped, however, that in the event of the "suction" producer becoming a rival to gas, coke may be the fuel used to operate it. It will be seen that Mr. Rigby gives details of tests made with this form of producer, working with ordinary gas coke, from which excellent results are obtainable. This is not at all surprising, having regard to the general experience with what is a similar form of producer used for heating gas-retorts. The same authority gives the results of a test of a new type of gas-engine, in which the compression is carried to over 200 lbs. per square inch, or to nearly double that which has been previously effected; the tendency to premature ignition being prevented by drawing in a small quantity of water during the suction stroke. It is estimated that the effect of this will be to reduce the fuel consumption by from 10 to 20 per cent. Obviously, any such improvement in the economy of a gas-engine must be equally in favour of its use with town as with producer gas.

The growing competition of electricity for the supply of motive power is undoubtedly a matter of concern; and there is reason to believe the electric motor has a certain field for very small powers, from which it will not be readily displaced. Even for larger powers it possesses certain advantages over the gas-engine, in regard to convenience and the facility by which it can be operated, that may cause it to be preferred in some cases. Generally speaking, however—and especially in view of the price at which electric current is usually supplied—the electric motor is not now a serious rival to the gas-engine. Moreover, electricity can be, and is, generated by town gas at much cheaper rates than those at which it is usually distributed to consumers. That is a matter of common knowledge; but Mr. Clerk is apprehensive lest the "cut" prices at which electricity is supplied for power purposes, or the still lower rates at which it is proposed to supply under the ambitious schemes by which it is sought to distribute electricity from large centres over enormous areas, may have the effect of seriously limiting the use of gas for motive power, if not of taking from gas undertakings a considerable portion of their present supply for this purpose. He therefore urges that every effort should be made to bring down the price of gas generally to 1s. 6d., and even to 1s., per 1000 cubic feet. But to do this, the shackles must be removed from the gas industry, illuminating power disregarded, and all effort concentrated upon the production of gas of a calorific value between 500 and 600 British thermal units. There is nothing particularly new or startling in this pronouncement; for it is the aim of all progressive gas makers to supply gas at the lowest possible cost. And when Mr. Clerk says that he is sorry to see opposition by leading gas manufacturers to proposals for a standard of heating power, he has surely misapprehended the grounds of that opposition. It may be doubted if there is a single gas maker to-day who would seriously object to the substitution for the existing photometrical tests of a test for calorific value, provided that this were to be fixed sufficiently low to afford the necessary degree of freedom. That which is most strongly objected to is any disposition to impose such tests as additions to those which are already in force. It would, in fact, be practically impossible to comply with photometrical and calorific value tests concurrently made, since one might give a satisfactory result and the other the reverse. As to the desirability of the change which is so forcibly advocated by Mr. Clerk, there is not likely to be very much difference of opinion. We look, however, in vain to him for any guidance as to the way in which it is to be brought about. How to reduce illuminating power without proportionately reducing calorific value is a problem which the gas manufacturer has had before him for years, and which, so far, has only been but very partially solved. Increasing the production of gas per ton of coal carbonized clearly has the great merit which

attaches to procedure by steps; whereas any attempt to produce a cheap heating gas by means of a large admixture of "blue" water gas might have an unlooked-for and undesirable result.

Until, therefore, this problem is completely and satisfactorily solved, gas makers will have to make the best fight they can with the means at their disposal. Apparently, Mr. Bell—and no doubt many others—is doing this with very gratifying results. His system of hiring out gas-engines is one that should commend itself to Mr. Clerk; for by its means he has in four years more than doubled the number of engines in use. Gas for motive power is supplied at Derby at an average price of 1s. 10½d. per 1000 cubic feet; being a reduction of 5d. per 1000 cubic feet from the average charge for gas used for lighting, &c. This is considerably above the price advocated by Mr. Clerk; and, taken in conjunction with the great increase in the number of engines in use, shows that consumers are prepared to pay, in the shape of a comparatively high running cost, for the convenience, the cleanliness, and the reliability of a town supply. It may be inferred, however, that if the necessity should arise, the price of gas for motive power could be further reduced, without injustice to other consumers. Reference was made by Mr. Meunier, in the course of his Inaugural Address to the Manchester District Institution, to the great variation in the needs of industrial customers; and he then explained a scheme, of his devising, of differential charges, based upon the maximum hourly consumption. Applying this principle to the users of gas for power, it appears to Mr. Bell that in his case a reduction could be made to them of 9d. per 1000 cubic feet as representing the saving in labour and interest on capital consequent upon a constant every-day consumption. Whatever may be the figure in any particular case, the principle appears to be a sound one, and deserving of consideration. A differential charge which does no injustice to other classes of consumers should commend itself to all to whom an all-round reduction of any considerable amount is, for the present, an insurmountable difficulty.

The "Methane-Hydrogen" Gas System.

Gas manufacturing economists have to extend consideration to a new claimant for place in their operations. Perhaps "new" is hardly a proper description, for it is only so in so far as the process is a development upon an older system. It is the process to which has been given the distinctive title of the methane-hydrogen gas plant, which had its genesis in the fertile brain of Professor Vivian B. Lewes, and was first experimentally brought to a practical working condition by Mr. C. B. Tully, during the latter period of his management at Sligo. From time to time, information respecting the system—of a theoretical and experimental character—has been brought before our readers; but now we have in its application at Truro, through the enterprise of the Chairman (Mr. John James) and his co-Directors, acting upon the advice of their Engineer (Mr. S. J. Ingham), some results as to its working on a practical, though small, scale. There are so many matters attaching to the claims for the plant that it is only natural there should be a suspension of final judgment as to its superiority or otherwise in relation to other processes which it is intended to rival until the duration of its working has been extended, and more knowledge obtained as to its power to sustain its reputable performance so far at Truro. The plant (it will be seen from a report in another column) was formally inducted into service last Wednesday; and on the occasion it received the benison of Professor Lewes, who described it as representing, he thought, "the latest and most important development in the production of gas." That is, coming from such an authority, a statement full of significance.

A description of the installation at Truro was published in last week's issue; but, about the results of the working then appended to the article, there appears to have been a little misapprehension, though the cost of 8·92d. per 1000 cubic feet must have been regarded by many gas managers with envious eyes. When a new process is put forward without ostentation and startling claim, and shows promisingly, one feels inclined to extend to it, in its maturing period, the utmost indulgence; and therefore we would briefly suggest a few points for consideration in connection with the matter published in both the last and current issues. In the first place, the Truro plant has only been in operation something like three months; and, this being the pioneer installation, those months have seen certain minor changes to effect improvement. Under these and other circumstances which will be explained, the conditions of operation have not been those which tended to confer upon the plant its maximum ability in the matter of economy. It is assumed that readers have already made themselves acquainted with the process by a study of the description published last week; and therefore we will at once turn to the working particulars published on p. 228. The figures are incomplete; and it would have saved some misconception if further explanation had been accorded in the first instance, as it would have clearly shown how an enhancement in economy could be fairly expected. The two heaviest items in the account are the coke and the benzol. In reference to the coke, there are no figures which show the duration of the runs, which, of course, is a point that considerably influences the coke account in relation to production. The longest run in twenty-four hours has been 13¾ hours; but the average may be taken as not exceeding four to five hours. In the long intervals, the consumption of fuel in the generator has continued, and so have the charges for wages. This is not the fault of the plant; it is merely an incidence of the demand for gas. If the plant could be worked without any intermission for the twenty-four hours, the costs per 1000 cubic feet would, the records inspected suffice to show, be very materially reduced. For example, for the 13¾ hours' run referred to above, Mr. Ingham's return as to costs works out to 6½d. per 1000 cubic feet, as compared with the average of 8·92d. for the total runs made during the months covered by the figures. The item for coke has therefore been considerably affected by the shortness of the runs, and the consequent high stand-by charge for generator fuel.

As to the account for benzol, one of the claims for the plant is that tar can be profitably employed in it (in fact, its use is inherent to the system), and thus relieve the surplus for disposal. The high quantity of benzol appearing in the working statement last week is to be accounted for in two ways. It will be observed that no mention is made of tar being employed until the week ending Feb. 18, since which time, up to April 1, 1285 gallons were used. The reason for this is that the tar arrangements were not completed until the week referred to; and prior to then, no less than 750 gallons of the 1350 gallons of benzol used up to April 1 had been consumed—leaving the use of benzol at 600 gallons for the period during which tar was also employed. It will be seen that, excepting in two weeks since the tar was started, the weekly consumption of benzol has considerably diminished. Further, the amount of benzol used is dependent, in ordinary working, upon two factors—the percentage of the methane-hydrogen gas sent out, and the quality of the coal gas made. Where the coal gas is poor in illuminating power, the increased use of benzol for enriching the bulk ought not, of course, to be set as a disadvantage against the methane-hydrogen plant. As to the increased benzol consumption according to the percentage of the methane-hydrogen gas, we are informed that 20 per cent. could be sent out without any benzol enrichment; whereas at Truro they have been distributing mixtures containing from 30 to 50 per cent. of the gas. It follows, to bring the bulk up to the normal illuminating power, the larger the quantity of methane-hydrogen gas in the mixture, the greater the consumption of benzol. As an additional point of interest, it may be noted here that, with the use of light Scotch tars, richer results would be realized than with the heavier tars from English coals.

These explanations will, we think, cause the various figures (creditable as they are to the plant) to be viewed in a new light. The system starts on its career under auspicious circumstances; and the publication, as early as possible, of more comprehensive working records—giving, in addition to the classes of figures already presented, the hours of the runs, the percentages of the mixture, the quality of the coal gas, the illuminating power of the bulk, calculations as to the stand-by charges, and other points which may suggest themselves in working as useful—will better enable gas engineers to pronounce judgment on the system in comparison with the claims of plants and methods of operation which have greater age and extended use on their side. With all plants and processes, there must be the practical trial stage, upon which the search-light of competent criticism is bound to be steadfastly directed. The methane-hydrogen plant has to face the ordeal; and it promises to do so successfully.

For the Consideration of Non-Statutory Companies.

QUITE fortuitously there has come to our notice a matter of serious moment to non-statutory companies who may be contemplating an application to Parliament for statutory powers. It is dealt with at length in an article in another column; and the only object of mentioning it here is to give prominence to the suggestion that the dubiety which, it appears, still exists should be removed by some concerted action. The point at issue is simply this: The Inland Revenue Commissioners have—as limited liability gas companies are aware who have been to Parliament the last session or two—come to the conclusion that such companies on dissolution and incorporation as statutory companies are liable to an *ad valorem* duty as in the case of an ordinary transfer of property. The details affecting the matter are referred to in the article elsewhere. The Commissioners claim that it is a case of a transfer upon sale; but opinions differ on the point, though the weight of legal estimation of the validity of the claim is, it must be admitted, distinctly on the side of the Commissioners. They rely on certain decisions in the High Courts in support of their claim; but those cases are not precisely on all-fours with one in which a limited liability gas company are merely dissolved and becomes, by virtue of an Act of Parliament (passed as much in the interest of the public as of the company themselves), a statutory company. The difficulty in obtaining a decision which would finally dispose of the matter is that most of the limited liability companies who are interested, or would be on approaching Parliament, are comparatively small concerns, and can hardly be expected individually to bear the expense of submitting the question at issue to judicial arbitrament. Messrs. R. W. Cooper and Sons (who, on invitation from us, placed at our disposal the material from which the article elsewhere has been prepared) suggest that, by a combination of such gas companies, it might be possible to secure an arrangement with Somerset House by which a special case might be submitted to the Courts. That suggestion should be at once considered. Inquiry has also elicited the fact that the matter has not yet been formally before the Committee of the Gas Companies' Protection Association; but the little support the Association has hitherto received from non-statutory companies would not admit of their contemplating taking active steps in even a matter of such common interest as this, and against such a powerful body as the Inland Revenue Commissioners. The old complaint again comes in here, that the gas industry, opulent as it is, lacks an organization that is influential in respect of the one necessity to the greatest effective action.

The Affairs of the Paris Gas Company.

IN another part of the "JOURNAL" will be found our usual abstract translation of the annual report and accounts of the Paris Gas Company. They possess more than ordinary interest, inasmuch as they refer to the working of the Company in the penultimate year of their existence. In eight months from the present time the Company's concession will expire; and it is still uncertain what will be the *régime* under which the gas supply of the city will be furnished—whether by the Municipality direct or by someone responsible to that body. The situation is critical, but the Company are in no way responsible for it. They are conducting their business as though they had years instead of months of life before them; and the results of last year's working, as presented in the very full report and accounts submitted to the shareholders at their recent annual meeting, show unmistakably that their labours were attended with a considerable measure of success. There was an increase of about 662 million cubic feet in the quantity of gas sent out; 378½ millions of it being "day" gas. While the former figure represents an advance of 5·19 per cent. compared with 1903, the latter is 7·55 per cent., and brings the day consumption up to 40 per cent. of the total. The revenue necessarily followed this upward movement, and amounted to rather more than £4,000,000, against £3,864,000 in the preceding year. The result of the twelve months' operations was a sum of £1,728,000 to dispose of. After taking £448,000 to which their Treaty entitled them, the Company had the substantial balance of £1,280,000 left in hand. Half of this went straight into the coffers of the Municipality, and the rest to the shareholders, who carried away a dividend which with the interim payment in October made 80 frs. per share; being 4 frs. 50 c. more than that paid for 1903. Under existing conditions, the Municipality participate, as will be seen, to a not inconsiderable extent in the Company's prosperity.

The principal feature in the technical portion of the report is the statement in reference to the public lighting. During the past few years, the old flat-flame jets have gradually given place to incandescent burners, of which there are now in use 51,519, compared with 2286 of the ordinary type. It seems only a few years since the two rival systems of lighting—gas and electricity—were struggling for supremacy in the streets radiating from the Place de l'Opéra; and now the incandescent mantle is to be seen all over the city. In fact, the report shows that there is very little left to be done in introducing it. Another noteworthy point in the report is the increase in the number of consumers availing themselves of the Company's offer to put in gas-fittings gratis. While those of the ordinary class increased by 12,159 last year, the others augmented to the extent of 14,834. The Company some few years ago felt that they must go with the times; and their decision to adopt free fitting has brought its reward in the shape of considerable accessions to the books. The rising pipes which are features of the houses in Continental towns, and which convey the gas to all the floors, greatly facilitate the provision of a supply, as is evident from the fact that there are now 407,000 of the Company's customers—nearly 74 per cent. of the entire number—supplied from these pipes; 25,000 having been added last year. The show-rooms established in various parts of the city are naturally found to be valuable auxiliaries in the development of business. In view of the present position of the undertaking, as shown by the last report, the Directors feel that the Company can contemplate the approaching termination of their concession in the consciousness that they have fully discharged their duty towards the city, the authorities of which have profited largely by the undertaking, inasmuch as, in the fifty years it has been in operation, they have had handed over to them in different ways close upon 600 million francs, or about £24,000,000. This is a large amount to have taken out of a commercial Company; and it is not going too far to say that by it the municipal exchequer has been enriched at the expense of the gas consumers.

The North of England Meeting.

THE meeting of the North of England Gas Managers' Association, which was held at Newcastle on Saturday, was one which should prove of great value to gas managers, and to all who are interested in the supply and sale of gas. Mr. Dugald Clerk's lecture on "Coal Gas and its Rivals for "Motive Power," without doubt, considering his unquestioned pre-eminence as an authority on the subject, proved the main attraction to the numerous company that assembled. Mr. Clerk's inability to deliver the lecture in person was regretted, though more on account of the loss of the opportunity of making his acquaintance than on any other ground; for the lecture which he had prepared was replete to overflowing with a wealth of detail that was equal to the satisfaction of the most exacting of hearers, and in its delivery by his partner (Mr. M. A. Adam) it lost none of its power. The lecture is referred to in the editorial on "Power Gas;" and therefore requires no further mention here. The paper (which supplied the second course of technical fare) was by Mr. J. Chisholm, of Hull, on his successful experiments with the manipulation of the hydraulic seal. It was the contribution of a junior in position but a master in action. The subject he tackled is one on which there is still some obscurity, and great diversity of opinion and practice. The aim of the paper was to show a method, which the author has successfully introduced, for drawing off the tar and retaining an efficient liquor seal. He showed how he has accomplished this; and while his method may be open to some of the criticisms with which it was received, there is no getting past the fact that, in working, the appliance has given every satisfaction, and has, it is claimed, added very materially to the profits of the undertaking, while costing very little in its adaptation. On the general matters before the meeting, the report of the Committee shows that they have had a busy year. They have assisted in the important work of the training of gas engineers in the Rutherford College, Newcastle, and have been the means of providing some effective financial assistance in that work. They have also completed the affiliation of the Association with the

Institution of Gas Engineers. The presidency for next year goes to Mr. Matthew Leaf, of York, whom we heartily congratulate on his election to the post. He is a gentleman particularly well fitted for leading such a vigorous body as the North of England Association; and we fully anticipate that during his year of office the traditions of the Association will be efficiently maintained.

Photometrical Tests of Street-Lamps.

We are indebted to Mr. Clifford C. Paterson, Assoc. M. Inst. C.E., for a communicated article describing some street photometrical tests made at Teddington. Mr. Paterson, readers who were interested in our recent account of the work carried on at the National Physical Laboratory will be aware, has charge (under Dr. Glazebrook) of the photometrical department there. These particular street tests were made with ordinary "C" Welsbach gas-burners and with Nernst electric lamps of the vertical filament and "Luna" types. But the tests lose some value on account of the omissions in the article, though we are perfectly satisfied that in any tests with which Mr. Paterson is concerned, the utmost care would pervade them; while with the apparatus at the laboratory for ensuring constancy in the photometrical appliances, no doubt can be cast on the results on this score. But if we knew more about the conditions of the lanterns in which the gas-burners were ensconced, the quality of the gas, the actual (instead of the nominal) rate of gas consumption, and so on, we should be able the better to judge as to how far the results are applicable to other conditions. We are left in the dark on all these points. In the first place, the Welsbach "C" burner does not show the same efficiency as other burners of Welsbach make, consuming no greater quantity of gas than that attributed as the nominal consumption of those tested; while the Nernst lamp is the best obtainable of its class. The Nernst lamp, too, is a thing complete within itself, and self-reliant for returning the best results in early life, with a given constant voltage; whereas the incandescent gas-burner in street work is largely dependent upon the character of its lantern, and an unsound lantern will cause a great variation from the best possible results of the burner. The same thing applies to the adjustment of the burner to the quality of the gas. But we do not understand that Mr. Paterson took the precaution to see that this was done, in order that the results might not be vitiated. It does not appear that he did this, because there is no reason why lamp No. 1 on June 16 should only return 0·172 candle-feet, while No. 3 was giving 0·320 candle-feet. Therefore, without further explanation, one hardly knows what amount of reliance is to be placed on the figures.

Some Wide Differences.

It will be seen that the two systems were compared in terms of the illumination produced by each on a horizontal surface placed 7 feet away from the centre-line of the lamp-post, and 5 feet above the ground; and it will also be remarked that, with distance testing, the falling off in illumination was about 5 per cent. more in the case of the "Luna" lamps than with the gas-lights. But nothing is said in this regard about the Nernst vertical lamps. In fact, all through the tests, the vertical filament type lamps come out badly, considering the amount of current used. Mr. Paterson speaks of the electric lamps showing greater constancy in illumination; but when the several figures are examined, there are some extraordinary differences between Nos. 1 and 2 vertical type of lamps and Nos. 4 and 5 of the "Luna" type, which shake one's confidence on the point of constancy, and which would be all the better for explanation. In the case of the vertical filament lamps, there is a difference (between Nos. 1 and 2) for June 9 of 0·175 candle-feet, and for June 13 of 0·265 candle-feet; while in the case of the "Luna" lamps (Nos. 4 and 5), there are differences of 0·170 and 0·100 candle-feet. It would be of interest to learn the ages of these various electric lamps, as there has been published a statement which attributes to the new form of the Nernst lamp a shorter life than the old form. The last set of calculations in the article enables one to find that for 100 cubic feet of gas 24 incandescent gas-lamps can be maintained alight for one hour, as compared with 8½ Nernst lamps for one unit of electricity. Whatever computations are made with these figures as a basis, if gas is not abnormally dear, it will be found to come out the cheaper of the two. Several workings of great interest can be made from these figures, and applied to everybody's local conditions. Our only regret is that more information is not afforded on details which affect the results, and rob them of general utility.

Arbitrators and their Awards.

The past few weeks have witnessed two somewhat remarkable attempts on behalf of disappointed parties to upset awards made in arbitration cases. In both instances it has been Local Authorities who have thus striven to avoid payment of amounts for which they were held liable; and the results of the endeavours have been such as will afford little encouragement to others to follow their example. The first case, of course, was that which arose out of the purchase by the Liverpool Corporation of land at Rivington belonging to Mr. W. H. Lever. The Corporation objected to the price they were ordered to pay; and it was necessary for Mr. Lever to invoke the aid of the Law Courts to secure the carrying out of the award. The second case occurred in Ireland; and though the amount involved was very much smaller, it is nevertheless of considerable interest to "JOURNAL" readers, inasmuch as it relates to a gas-works purchase arbitration. In 1902, the Omagh Urban District Council obtained an Act enabling them to acquire the undertaking of the Omagh Gas Company, as provided for by the Company's Incorporating Act of the preceding session; and about twelve months ago, during a three days' hearing, the facts were placed before the Arbitrator who was appointed to determine the amount to be paid. The sum eventually arrived at by him was (as not unusually happens in such cases) considerably more than the Council had imagined that they would have to pay; and, after a great deal of talk, the matter was brought before three Judges of the King's Bench Division of the Irish High Court, as reported last week (p. 242). The judgment, which appears in our "Legal Intelligence" to-day, is not calculated to assist the Council any more from a moral than from a material standpoint; while the remarks made, especially by the Lord Chief Justice, should have a chastening effect upon the gentlemen who conduct the public affairs of Omagh. The Act stated that the concern was to be valued as a non-statutory one; and the Arbitrator said he had done this. The Council, however, argued, in spite of all, that the purchase-price was based on the value of the undertaking as a statutory one, though they did not take steps to dispute the award in the first instance, as they were legally entitled to do. The dismal failure of this effort to upset an award by a side-wind, as it were—"an after-thought, because the sum was regarded as inconveniently large," one of the Judges termed it—in addition to being a satisfactory ending of the matter for the Omagh Gas Company, will do something to maintain the confidence of other companies whose undertakings are about to be acquired by local authorities, that their interests are not likely to be prejudicially affected by submitting the case to arbitration.

Gas Testing at Wexford.

Legal affairs in Ireland, however, are not exhausted by the "wriggling" of the Omagh District Council, for the Corporation of Wexford have also been engaged in a bout with the local Gas Company. This was with regard to the illuminating power of the gas; and the proceedings ended in the Company being mulcted in the sum of £5. Over here the summoning of a company for supplying gas of deficient quality is not a matter that "draws" the public; but in Wexford things are evidently different, for we learn from the local paper that when the case was called the Petty Sessions Court was densely crowded in every part. The most prominent townsmen were in attendance; and "there was every manifestation of unusual public interest in the proceedings." Those who journeyed thither in the expectation of a treat were by no means doomed to disappointment; and they will no doubt long remember the cross-examination of the Corporation Gas Examiner by Mr. Tim. Healy, and his subsequent denunciation by this extremely eloquent King's Counsel and Member of Parliament. The Examiner in question was none other than Mr. T. J. Cotton, to whose work in Dublin the "JOURNAL" has on more than one occasion had to refer. Mr. Cotton stated that the prosecution was brought against his wish; and if he had the slightest premonition of the part he was to play, it would be easy to understand

that this was the case. It is safe to say that seldom in any Court has a technical witness been so severely handled by Counsel; but the Bench felt themselves fully justified in acting upon his certificate—which, according to Mr. Cotton's own evidence, is more than the Corporation of Dublin have ever done—in spite of the evidence of the Assistant-Manager (Mr. A. Lyne) that his own tests, taken after Mr. Cotton's, showed the gas to be over the statutory illuminating power. The people of Wexford have been well served in the matter of gas supply—the price charged being, with one exception, the lowest in Ireland; and it is to be hoped that we are not going to witness between the Company and the Corporation that lamentable strife which has at times been so manifest in Dublin. This prosecution, however, taking place as it has done so soon after the appointment of the Corporation Gas Examiner, does not hold out any very great promise of increasingly friendly relations.

The Annual Meeting of the Société Technique.

The usual preliminary notice, giving a brief outline of the programme of the proceedings at the forthcoming annual meeting of the Société Technique de l'Industrie du Gaz en France, which, as already announced, will be held at Havre next month, has just been issued by M. Georges Visinet, the President. On Tuesday, June 20, the ordinary general meeting will be held in the morning for the transaction of the customary formal business—namely, the admission of new members, presentation of the reports of the Council and the Treasurer, and the election of new members of the Committee. In the afternoon of the same day, the congress proper will be opened by the Presidential Address, followed by the distribution of awards (which figure so largely in the French Society's proceedings) and by the reading of the papers. These will be continued on the morning of the 21st; the afternoon being devoted to visits to various works, with the annual dinner in the evening. On Thursday, the 22nd, the European Gas Company, who light the town of Havre, will be the hosts of the Society during an excursion and lunch. Friday, the 23rd, will bring the meeting to a close with the remainder of the technical papers to be read and discussed.

The Salary Question at Devonport.

In spite of their recent questionable action, the Devonport Gas Committee are to be congratulated upon having shown more wisdom in regard to the salary which it is proposed to pay the new Gas Engineer than was manifested by many members of the Town Council. The so-called economists who are members of that body belong to a class who are a real danger to the cause of municipal trading. Their ideal of the management of municipal business is associated with a cheeseparing economy which disregards every consideration but that of obtaining the services of other men at the lowest possible rate. Several of them have been loud in their denunciation of the past administration of the gas-works, and have been clamorous in demanding an inquiry and for changes. Now they talk of gas making as a very simple process, as a mere matter of routine which can be carried on by anyone, and advocate the appointment of a kind of working foreman as Manager, at a salary something less than any big works would pay to a foreman. The Gas Committee have not erred on the side of generosity. In offering a salary of £450 a year without a residence, coal, and gas, they have cut the remuneration down to a very low point; but the Committee nevertheless look forward to obtaining the services of an Engineer and Manager who will not only be competent to discharge the ordinary duties of the position, but also, if they can get rid of the Consulting Engineers (as is only too clearly their policy), to superintend the erection of the new works.

A Municipalizer on Controlling Municipal Expenditure.

It is always good to hear the views of different people on a question under discussion, and it is specially gratifying when these views accord with one's own. We are therefore pleased to find that Alderman Gainsford, of Sheffield, has addressed "The Times" on the subject of "Municipal Expenditure," which is just now very much to the front. As Chairman of the Water Committee of the Sheffield Corporation and of the Derwent Valley Water Board, he can put forward a very good claim to be heard; and while his experience makes him distinctly favourable to municipal enterprise as a principle, and within fair limits, he is by no means satisfied with things as they are. In view of recent criticisms, he strongly advises the establishment of a department of municipal audit, separate, if possible, from the Local Government Board, to "audit, and to some extent to control, municipal trading and loans." The proposed department would be specially designed to bring the accounts of all works into intelligible uniformity of shape and into thorough trustworthiness of results. This is his first suggestion, and it is a most commendable one. An investigator into the expenditure of a municipality requires, in the first place, to have before him accounts that can be easily understood; and, secondly, to be assured that he may rely upon them. Alderman Gainsford's second suggestion touches the side of the municipal question which has lately been presented so conspicuously to the public. He thinks some limitation should be put upon borrowings, especially for purposes which may be classed as "optional," as distinguished from necessary objects, such as lighting, water supply, and sanitary works. Unfortunately, the tendency of the age is rather in the direction of expenditure on the unnecessary; and the sooner it is checked the better it will be for everybody, especially the ratepayers. Certainly, a beginning would be made by the adoption of Alderman Gainsford's suggestions, whereby, as he says, "confidence would be increased, good works would be helped, and mistakes prevented." We trust he may soon have an opportunity of developing the views he has put forward, all too concisely, in his interesting and well-timed letter.

Milan Gas-Works and Municipalization.

The Milan Correspondent of the "Daily Telegraph" wrote last Friday: "For several days a heated discussion has been going on here between the advanced and the monarchical parties about the municipalization of the gas, which is at present supplied by a French private Company [the Union des Gaz]. The question is a most important one, as Milan consumes some 125,000 cubic mètres daily. The Radicals and Socialists claim municipalization as one of the principal planks of their platform, while the Monarchists, who are now in a majority, oppose it as bad finance. Popular meetings and demonstrations have worked the excitement to fever-heat. To-night the proposal was rejected by the Town Council."

British Association of Water-Works Engineers.

We learn from the Secretary of the Association (Mr. Percy Griffith, M.Inst.C.E.) that the annual meeting will be held at Hastings on June 29 and 30 and July 1. The Water Engineer to the Hastings Corporation (Mr. P. H. Palmer) is the President for the year; and for this reason, as well as the attractions of Hastings and the district, both in respect of technical interest and pleasure, there is sure to be an excellent attendance. The number of days devoted to the meeting are less than formerly—there being a feeling among the members that the old arrangements were somewhat of a strain upon them—particularly as, to faithfully go through the programme, practically a whole week was absorbed. It may be, too, that the shortening of the summer assembly may have a beneficial influence upon the attendance at the winter meeting. The programme for the June meeting is now in course of construction; and the names of the authors justify the expectation of papers of good technical merit. An important piece of business for consideration will be the revision of the rules, in accordance with a draft prepared by the Council, in order to bring them up to date. The old, cumbrous title it is proposed to judiciously shorten to "The Association of Water Engineers." It is intended to increase the entrance and annual subscription for new members. The associate divisions ("A" and "B") of membership are also to come under fresh designations. Those gentlemen who at present constitute class "A" will in future (if the modified rules are approved) be called "associate members," while those occupying class "B" will simply be known as "associates." Two meetings a year are now held; and the rules are being amended to embrace the second one. Previous experience has shown the necessity for the alterations; and there is no doubt that their adoption will tend to improve the status of the organization. Their submission at the annual meeting will see whether or not they meet with the entire approval of the members. There really seems to be little about them to which exception can be taken, excepting perhaps that a few members may consider the increase in the subscription a little stiff for some of the engineers of the smaller water undertakings who may desire to become members. On the other hand, it may have the effect of attracting men occupying superior standing in the profession who may regard an Association with a low subscription as being somewhat beneath their notice.

FROM NON-STATUTORY TO STATUTORY CONDITION.

The Claim of the Commissioners of Inland Revenue for Ad Valorem Duty in respect of the Vesting in a Parliamentary Company of the Property of a Limited Company.

In the process of changing their rank from that of a limited liability, or non-statutory, concern to that of a statutory one, gas companies are in most cases subjected to various forms of embarrassment—such as (for small undertakings, as these mostly are) costly local opposition, the imposition of purchase clauses, and so on. Now, it has recently come to knowledge that those gas companies who have become incorporated during the last session or two, have had claims made upon them by the Inland Revenue Commissioners for the payment of *ad valorem* stamp duty in respect of the transfer, by their Acts of Parliament, of the property of the limited liability companies to the incorporated companies. The subject is one of great importance not so much individually but collectively to the companies who have not yet ventured to improve their estate, but who in time to come must do so for the protection of their interests; and even regarded from the individual standpoint, it is not a matter the importance of which we would desire to minimize. Every session of Parliament we have, on the average, ten or a dozen companies approaching Parliament asking to be clothed with statutory authority and powers. But since the Inland Revenue Commissioners have taken it into their heads to regard this change of condition as involving a conveyance or transfer on sale of property, and to claim an *ad valorem* duty in respect thereof, most of these companies have satisfied the claim without demur; while others have hesitated and objected until inquiry has shown them that, acting alone, the cheapest, easiest, and consequently the most sensible course is to pay the claim without running the hazard of bringing themselves into long contest with the Inland Revenue Commissioners. If there could be some concerted action, by which the costs could be borne *pro ratâ*, with the view of submitting a test case to the Courts, it would be an altogether different matter. The Felixstowe Gas Company, we recently heard, have taken some action to see whether those non-statutory companies who obtained parliamentary powers in 1904 would be disposed to unite with them in putting the matter to test; but they have had little encouragement to proceed in the matter —some of the companies having already paid the claim, others being in negotiation with Somerset House to determine what is the amount of the *ad valorem* duty, and others again not deeming the question one of sufficient importance to trouble themselves seriously about it. But there are companies who, on the claims being made, have not admitted their liability without due investigation, and satisfying themselves by obtaining the views of their legal advisers, and supplementing them by Counsel's opinion. And yet doubt exists in the minds of even men of the law, skilled in the interpretation of parliamentary enactment and judicial decision.

This being the position, it has been a matter of some interest to make inquiry with the view of ascertaining what are the chances of dislodging the Inland Revenue Commissioners from their attitude in claiming that such a change of condition as the dissolution of a non-statutory company and its incorporation as a company with parliamentary powers is, in fact, a conveyance or transfer of property, which justifies the claim of the *ad valorem* duty—that is to say, 10s. per cent. on "the market value at the date of the transfer of the shares in the new Company allotted to the shareholders of the old Company, *plus* the liabilities (if any) taken over by the new Company from the old." In looking into the question, the greatest assistance has been accorded to us by Messrs. R. W. Cooper and Sons, who, in their capacity as Solicitors to certain gas companies, and Mr. F. E. Cooper in his capacity of Secretary to the Gas Companies' Protection Association, have had occasion to specially consider the matter. In making use of the information which they have placed in our possession, we have in accordance with their request altogether omitted the names of Companies and of Counsel; but we may immediately say—having very carefully considered the whole matter, the legal decisions bearing upon the question, and the opinions of the eminent Counsel consulted—that (while others equally qualified to judge may entertain different views) there does not appear to be much doubt that the Inland Revenue Commissioners occupy a strong position, in assailing which those who may take the matter in hand must be prepared to carry the attack up to the House of Lords. At the same time, we must admit the hardship and the injustice of the legal right of the Commissioners, if such it is, seeing that, in reality, one cannot very well convey or transfer property from one's self to one's self. But the status of those who formed the non-statutory concern is not the same as that of those who constitute the parliamentary company.

Let us, however, examine the question a little more closely. The character of the provisions of Acts of Parliament under which limited gas companies are dissolved and re-incorporated are so ordinary as to be well known by our readers. By those provisions the property of the limited company is vested in the parliamentary company; and the original share capital is simply divided among, and vested in, according to their rights, the several persons, who immediately before the passing of the Act, are the registered members of the limited company. The obligations attaching to the shares before the passing of the Act are also continued. On the face of this, there does not appear to be anything that the laymen would call a conveyance or transfer of property to cause the transaction to be subjected to *ad valorem* conveyance duty. The Inland Revenue Commissioners, however, see differently and therefore call upon those gas companies who take upon themselves parliamentary dignity and responsibilities, for, "in accordance with the provisions of section 12 of the Finance Act of 1895, a King's Printer's copy of the Company's Act duly stamped with *ad valorem* conveyance duty in respect of the vesting of the property of the limited company in the company incorporated by the Act." Consulting section 12 of the Finance Act of 1895, it is seen that it refers to cases where, by an Act of Parliament, property is vested by way of sale in any person, or any person is authorized to purchase property. It is contended by those who disagree with the Inland Revenue Commissioners, that the vesting in the statutory gas company of the property of the limited company is not a "vesting by way of sale;" and, therefore, as property is not purchased under the Act, the provisions of section 12 of the Finance Act do not apply. It has before been remarked that, according to the Inland Revenue authorities, the consideration on which duty is chargeable appears to be the market value at the date of transfer of the shares in the new company "allotted to the shareholders of the old company," *plus* liabilities (if any) taken over by the new company from the old. It further seems to those who dispute the right of the Inland Revenue Commissioners that the use by them of the above expression "allotted to the shareholders of the old company" indicates that the Inland Revenue consider there is some analogy between a re-constitution of a company under the circumstances and a reconstruction of a company under the Joint-Stock Companies' Acts; and that the vesting is more or less analogous to a transfer or conveyance of assets, as in the case of a reconstruction of a limited liability company. A little consideration, it is maintained, shows that there is no analogy between the circumstances of the two cases; there being, of course, in the case of a reconstruction of a limited company a conveyance for a consideration, pursuant to an agreement between the parties, of the assets of the old company to a new one, consisting, it may or may not be, of new members. To constitute a sale, there must, it is argued, be not only a transfer of property from one entity to another, but such transfer, it is submitted, must be in pursuance of an arrangement between such entities by which one for a certain consideration conveys property to the other, as in the case of *John Foster and Sons v. Commissioners of Inland Revenue*, upon which case the authorities rely in support of their claim. But there is no such arrangement or bargaining where a statutory company is simply dissolved and reincorporated; and all that happens is that, on the constitution of the parliamentary company, the assets and liabilities of the limited company are transferred to the parliamentary company, and the shares of the latter are vested in the members of the limited company. But, as a matter of fact, it is urged, there is no sale, and consequently no consideration. The whole of the provisions of the Private Act in such a case, it would seem, merely constitutes a bargain between the parliamentary company and Parliament on behalf of the public. These Private Acts do not themselves recognize anything more than a change in the status of the company; and it does seem hard when a limited company takes a step which is obviously in the interests of the public—and, indeed, it seems to be a straining of the provisions of the Act—that they should be mulct in a heavy conveyance duty.

However, that is shortly one view of the case; the other is presented in the opinions of Counsel and in the judicial decisions which stand recorded as precedents. While it is admitted that the position is not free from difficulty by one Counsel, both he and an eminent King's Counsel are of opinion that the contentions of the Commissioners of Inland Revenue are well founded. In their written opinions, the cases of *John Foster and Sons, Limited v. Commissioners of Inland Revenue* (which was an appeal in 1893 from a decision of the Queen's Bench Division), *The Great Western Railway Company v. Commissioners of Inland Revenue* (also an appeal in 1893), and of *John Wilson and Sons, Limited v. Commissioners of Inland Revenue* (First Division of the Court of Session, 1895), are frequently quoted and relied upon. The one having greatest application is undoubtedly that of Foster and Sons. In this, eight persons who had for many years carried on business in partnership, determined the partnership, transferred their business, freehold and leasehold properties, trade marks, &c., to a limited company, formed exclusively of themselves; all the shares and debentures of the company being allotted to them in proportion to their respective shares in the partnership. The deed by which they conveyed and assigned all the partnership property to the company was dated November, 1891; and the question arose as to the amount of stamp duty payable on such deed under the Stamp Act, 1870. It was held that the deed was a "conveyance or transfer on sale" within the meaning of the Act of 1870—it being an entire transfer of the property from one party to another, and therefore was chargeable as such with an *ad valorem* duty. Well, now, in the case of a limited gas company upon whom parliamentary powers are conferred, is the property vested by way of sale in any person? Counsel find it impossible to draw any material distinction

between such a case and that of Foster. In the latter, the vesting was effected by deed; and in the case of the gas companies, it is by Act of Parliament. With the passing of the Act into law, there is, it is contended, a transfer of property from one company to another for a consideration in shares. It is also the opinion of Counsel that the meaning of the words "vested by way of sale" is the transfer of property from one ownership to another ownership for a consideration in money or money's worth, and not being by way of mortgage, partition, exchange, or gift. In both opinions, too, Counsel are agreed that the consideration chargeable with stamp duty is properly assessed by the Commissioners—that is to say, they are entitled to assess on the marketable value of the shares of the parliamentary company at the time of the allotment, with the addition of any liabilities, seeing that the latter form part of the consideration given for the property transferred to the parliamentary company. It seems to be pretty clear that it is no use trying to obtain exemption from the claim by any mere cuteness in the matter of the phrasing of clauses in Acts, as was well illustrated in the case of *Attorney-General v. The Gaslight and Coke Company*, as reported in the "JOURNAL" for April 22, 1902. That case had reference to the claim of the Inland Revenue in respect of stamp duty on the conversion of the share capital; and there it was held that the Crown were not bound by Local or Personal Acts to which the Crown was not a party.

We have endeavoured here to present (by the aid of the material kindly placed, by request, at our disposal by Messrs. R. W. Cooper and Sons) both views of the matter, without unnecessary elaboration. It would seem that, if the Inland Revenue Commissioners have not justice on their side, they have the law. But still there is a doubt; and the only way to sweep away that doubt is by a test case. This would cost perhaps a fairly considerable amount of money; and the Inland Revenue Commissioners would probably not rest satisfied with any want of success until the verdict of the highest tribunal was obtained. For the saving of the few hundred pounds which they might effect, no single gas company could stand the risks of litigation of this kind. Nor is it likely that the Gas Companies' Protection Association would regard such litigation as coming within their province, though we cannot understand why it should not, if they had the available funds. "Protection" certainly suggests something more than an advisory and a watchful office. It therefore appears that, if the matter is to be finally settled, it can only be by an amalgamation of forces by those companies who have not yet ventured to Parliament, or who, having ventured, have not yet met the claim of the Inland Revenue Commissioners. To such companies collectively, it is a matter of great interest and importance.

ELECTRIC LIGHTING MEMORANDA.

Small Towns and Electricity Supply in Bulk—Some Computations—A Liverpool Protest—Profits, Large and Small, at Leicester and Hastings—An Obstacle to Further Speculation at Torquay.

IT is (or if it is not it should be) a question of considerable interest to the local authorities of small towns as to which is the cheaper method of obtaining a supply of electricity—to take it in bulk from a power supply company, or to put up independent generating plant on their own account. The unfortunate thing is that decision in this matter practically rests with the expert adviser, whose commission on the subsequent capital expenditure would be seriously diminished by carving out of a scheme the plant other than that required for the purpose of distribution; and it would also greatly lessen the demand for the services of the gentlemen who have made a good thing out of the establishment of unproductive electrical undertakings. If ever the race of electrical engineers becomes extinct who cannot advise as to the improvidence of local councils going in for electricity works where serious risk stares them in the face, the ratepayers will be the last to have cause for regret. However, the Local Government Board seem rather favourable to the shortening of the rope that these gentry have had; and at the rate the Board are going now, together with the piling up of the records of broken promise or false prediction, some of these "advisers" will shortly find themselves much discredited. The Board are rather inclined to counsel small authorities to obtain their current, wherever possible, from bulk supply companies rather than put up expensive generating plant of their own. But their advice is not particularly palatable to those who have taken their stand in an already over-crowded region of professional employment. Of course, for the authorities of small towns there is not such risk of great financial difficulty in taking electricity in bulk from a supply company, and simply having to bear the capital and working costs of distribution, rent, rates and taxes, and management and office expenses. Therefore, under such circumstances, the ratepayers will suffer less than when authorities of the minor category enter into the whole business from the generation of the current.

Some interesting computations on the subject, by "A Power Station Engineer," appear in the "Electrical Times" this week; and, in view of the trend of events, they are exceedingly interesting. He lays down, in the opening part of the communication, two general conditions, which it is believed can with safety be applied in practice. The first is that the total capital expenditure, where the current is obtained in bulk from a supply company, should not exceed a sum on which the annual charge will be not more than one-third of the probable total revenue; and the second condition is that the average price received per unit must exceed the price paid by 85 to 100 per cent., to provide for distribution, management, interest, and sinking fund. The writer bases his calculations on a town having 15,000 inhabitants; but some of his figures strike one as being remarkably low. However, he reckons that for such a town there would be a capital expenditure of £11,250, on which interest and sinking fund would amount to £675. The consumption he puts at 112,500 units per annum; and the charges on the maximum demand system at 7d. and 2½d. per unit, or a flat-rate of 5½d., public lighting 3d., and power 4½d. to 1½d. But it is necessary that an average price of 4¼d. should be secured. This would give a revenue of £1990; and adding 3½ per cent. for meter-rents, a total of £2060. This is all very interesting; but the average price of 4¼d. is rather heavy for working up business in a small town. But our "Power Station Engineer" is not extravagant, as is seen by the statement that wages, repairs, maintenance, &c., rents, rates and taxes, and management and office expenses are all to be covered by £345 per annum. There is a fat job here for the skilled manager and those under him, after paying from the £345 the expenses mentioned other than salaries and wages. But we add this £345 to the £675 for interest and sinking fund charges; and there is a balance of revenue of £1040 to spend on current. This allowing 8 per cent. loss in distribution and for contingencies, permits 2·05d. per unit to be paid for energy. So, after the fashion of fiction, things come out right in the end—to a penny in this case. But it is all a question of chance; though the chance is not so great as when local authorities in these small towns erect and run the whole generating plant themselves. Of 23 towns with their own generating plants, with populations not exceeding 20,000, and in their third year (or less) of working, only three, according to the returns published at the beginning of March, made a profit, and of ten towns, with undertakings over three years old, only two made a profit. Some of the people in these towns have abandoned hope of ever seeing anything so cheering as profit on their electric lighting undertaking, though it seemed so near in the days of great local excitement when the foundation-stones of their generating-stations were "well and truly laid." Now, many of the local celebrities who voted light-heartedly for speculation wonder how it was in those days they were so gullible. From the figures before us, it does not appear that there are many of these small towns which would make an electricity undertaking pay, even if they purchased the current in bulk.

The expected comes at last. The consumers of electricity for private lighting purposes at Liverpool are deriding the sanctity of the power and traction load-factors, and are inquiring among themselves why there should be any special privilege in respect of charge for these purposes, and, further, why they (the lighting customers), who contribute so heavily to the revenues of the electricity department, should not have the benefit of the surplus balances in a reduction of their charges. They have a grievance here; and they cannot be convinced of the justice to themselves of £16,934 being taken from profits made out of them last year to ease the burdens of the general body of ratepayers. There is, of course, no valid defence to this plundering of the customers of municipal supply undertakings. Just as every municipal trading concern ought to be conducted without recourse to the pockets of the ratepayers who have no dealings with it, so ought those who support it with their custom to get the ultimate advantage from it, after all fixed and judicious charges are provided for. The average charge for electricity for lighting purposes in Liverpool last year was 3½d. per unit; the average charge for power supply was 1¼d.; and for tramway use 1¼d. Both the power and traction supplies have been put on even better terms in this year. The protest of the users of electricity for lighting will, we hope, have proper effect.

The accounts of the Leicester Corporation electricity supply undertaking must possess interest for our readers if only from the fact that Mr. Alfred Colson has engineered to notable prosperity this as well as the gas undertaking. The last three years have shown a remarkable spurt in net profit, compared with 1901, though 1903 had a set-back as compared with 1902, owing to abnormal causes. But last year, with a net surplus of £6518, exceeded the preceding year by £2268, and 1902 by £1703. All round there are increases in connections, output, and revenue; and the working costs—being lower in the total than in the preceding year—are testimony to diligence in effecting economy. The gross profit is £3925 more than in 1903; and to interest and sinking fund being on the ascending scale must be attributed the fact that the net surplus is, as already mentioned, only £2268 more. There are three or four other salient features about the profitable Leicester undertaking of which other local authorities who have difficulty in making both ends meet without burdening the ratepayers directly or through the public lighting, might make note. There is no public lighting by electricity at Leicester, no traction supply, and the price charged for current for private use is 4d. per unit, and for power 2d. per unit. Nevertheless there is the surplus for last year of £6518. Running from this great Midland industrial centre down to popular Hastings, it is found that the Corporation electricity accounts for the past year have also been issued; and the eyes are astonished on beholding that there

is a "surplus" of £117—the first indication of anything so nice since the Corporation took charge of the business in January, 1899. The average prices for private supply and public lighting are still high—5·03d. and 3·48d. respectively; but the Corporation cannot afford with their heavy capital to yet think of reducing these charges. The price charged for public lighting, however, has been 0·12d. per unit more than in 1903; and on a consumption of 228,976 units, this will make a considerable difference. Perhaps the Corporation will "relieve" the rates with the surplus of £117, or establish (if they have not already done so) a reserve or depreciation fund! With an expended capital of £136,819, they ought really to do something of the kind.

The Torquay Corporation are in trouble—the result, on the one hand, of a glaring piece of imprudence on their own part, and, on the other, of the Local Government Board having concluded that the ratepayers who opposed the application of the Council for a loan of £42,000 for new electric lighting and power works vindicated to the full their attitude. The Board have urged the Council to reconsider their proposals, on the grounds that they are satisfied there would be a serious loss for at any rate the first few years, and that the scheme involves the suppression of plant at the existing power station and at the refuse destructor, on which there is an outstanding debt of £8700. The Inspector is also of opinion that improvements at the present station can probably be effected which will render it sufficient for the supply of energy for lighting purposes for some years to come. The Corporation have tried to obtain an interview with the central authority, but unsuccessfully—it being contrary to the practice of the latter to receive deputations on such matters. There was a great deal of fulmination over the matter at the meeting of the Council on Wednesday, as their position is well described by that expressive piece of metaphor, "between the Devil and the deep sea." There is the immovable Local Government Board on the one hand and the Dolter Electric Traction Company on the other, with whom it appears the Corporation (unless this is merely being put forward as a *ruse de guerre*) entered into a very imprudent agreement, without making it subject to the Board's sanction to the loan. The Traction Company assert that they will be ready to take current from the Corporation during the first week in August next, and have warned the latter that they will hold them liable for any loss sustained after the tramway is laid. It is in connection with this application for a loan that the Torquay Gas Company asked the Board to put the Northumberland clause into operation; and the judgment of the Board shows that the Company were not seeking anything unreasonable. The rates of Torquay are already high; and many other ratepayers besides the Gas Company looked anxiously at the impetuosity of the Corporation in endeavouring to commit the borough to a scheme involving so much uncertainty. The effect of the representations that are to be made to the Local Government Board will be watched for with interest—not only by the ratepayers, but by many outside Torquay, as there are numerous electricians who are mournfully shaking their heads over this new awakening of the Board to their duty, and those who have to contribute largely to the public purse are right glad to find that there is at least one body strong enough to exercise restraint over these frenzied municipal speculators.

THE MECHANICAL HANDLING OF MATERIAL.*

THE above title is not a new one in the columns of the "JOURNAL," nor is the subject of transport appliances by any means a stranger to its pages. On the contrary, for years past the developments of labour-saving machinery and the adoption in gas-works of coal and coke handling plants have been faithfully recorded and profusely illustrated. We have little doubt that a patient collector of such articles could not but succeed in compiling from them a fairly comprehensive treatise. This suggestion occurs to us as a result of reading an imposing volume of some 500 pages, and of even more illustrations, bearing the above title, the author being Mr. G. F. Zimmer.

The intention, as is indicated by the long sub-title, "A treatise on the handling of material such as coal, ore, timber, &c., by automatic or semi-automatic machinery, together with the various accessories used in the manipulation of such plant, also dealing fully with the handling, storing, and warehousing of grain," has evidently been to produce a work embracing every branch of an important subject—a subject that in itself includes several special departments of engineering. Therefore we can easily believe, as the author tells us in his preface, that his book "has not been the work of a day, or a month, or a year," but that its origin dates back some twenty years. That it has a more recent and direct origin we can also well believe, for a paper by the same author, under the same title, was read before the Institution of Civil Engineers on Feb. 24, 1903 (not the 17th as is stated in the preface), and was fully referred to in the "JOURNAL" of March 3 following.† We have compared several passages in the work now under review with the paper referred to, and found them all but identical, such as the paragraphs on "Gear Drives for Elevators," and "Power Required for Elevators," besides others relating to band and vibrating conveyors. This may perhaps hardly be surprising; and, of course, there is a considerable amount of fresh matter given, dealing with weighing, railway trucks, skips, ropeways, and grain silos. But we mention the matter, because the observations that we made at the time on the paper apply also to some extent to the present work. Further, it relieves us in some degree of the obligation of any detailed review of the book itself, or of those parts of it of interest to our readers, which we should otherwise have deemed necessary.

The author divides the subject roughly under four broad heads: Continuous handling of material; intermittent handling; loading and unloading appliances; and miscellaneous—under the last of which come automatic weighing and coal-handling plant for gas-works. There must always be certain difficulties in the logical and exact arrangement of a work of this kind; but we think Mr. Zimmer's classification might be improved upon in some particulars. For instance, early in the book, under Chapter IV. on push-plate conveyors, we get a description of one of the first patterns of West's Gas Improvement Company's hot-coke conveyors. But why is this not transferred to Chapter XIV., "Conveyors designed for Special Purposes," where the coke plant at the Gaythorn Gas-Works is described, and one or two other hot-coke conveyors are mentioned? Then, again, while on this point of arrangement, why should a paragraph of six lines only be devoted to "Coke-Breaking and Sorting Plant," in the middle of the Chapter XIV. already referred to, when its natural place would seem to be much later, in Chapter XXIV. on "Automatic Loading Devices," where similar plants are dealt with?

Let us now very briefly just glace through the book, and draw attention to those items relating more particularly to gas engineering. The elements of elevators and conveyors generally can be passed over, though perhaps a table giving the inclines in inches per yard of shoot at which coal will fall easily may be of interest:

Mixed coal (large or small) requires .	15¾	inches to the	yard
Cobbles.	14½	,, ,,	,,
Nuts.	15	,, ,,	,,
Slack or small coal	19	,, ,,	,,
Cannel coal	14½	,, ,,	,,

Band conveyors, we learn, are due to the invention of Mr. Lyster, the Engineer to the Liverpool Docks, who experimented about 1868, since which, as we know, American engineers have adopted and greatly developed this class of conveyor. The horse power required for a band conveyor for minerals, with a load of 50 tons and a length of 100 feet, is 5; while a swinging conveyor requires from 8 to 9, a push-plate about 13, and a worm conveyor, 25 horse power.

A special chapter is devoted to gravity or tilting bucket conveyors; but we are struck by the omission from it of any reference (with the exception of Messrs. Babcock and Wilcox) to the work of any British firm. The author's attention has been given entirely to American makers, as though they had a monopoly of this class of conveyor. No mention has been made of Dempster's "Tipit" gravity-bucket conveyor, nor of their equalizing spur-gear for elevators and conveyors.* Also, one would have thought the Schenck curve conveyor of sufficient importance and novelty to deserve some attention. It cannot be said that such omissions, besides many others, are due to time, for there are references to coaling of vessels in the Russo-Japanese War, and to the sinking of the "Retvizan" at Port Arthur in December last.

After a chapter on pneumatic elevators and conveyors, we come to the consideration of hot-coke conveyors. Here, again, the only references to such conveyors in England are to the Gaythorn one already mentioned, to that of the New Conveyor Company, and to the plant at the Margate Gas-Works. When one bears in mind the patient striving of so many engineers, and the excellent ideas of so many makers, in their efforts to deal satisfactorily with hot-coke, it hardly seems adequate, to put it mildly, to treat them in this attenuated fashion. It leads one to suppose that there must be other objects in the compiling of such a book besides the desire to examine and record all relevant appliances. The De Brouwer conveyor is described; but the small drawing of it is poor and confused, and would certainly convey but little information to one ignorant of its working. The conveyors at the Zurich, Basle, Mariendorf, and Cassel Gas-Works are also described; but more detailed accounts of them have long past been given in these columns. The use of the word "coal" where "coke" is meant, which occurs on p. 130, and frequently later on, pp. 377 and 381, also causes confusion and renders the descriptions obscure.

The second division of the subject—namely, that dealing with the intermittent handling of material—need not delay us long; for it concerns ropeways—aërial cableways, and appliances for coaling at sea. We notice, however, a rather amusing mistake, where, on p. 164, when describing a ropeway at Table Mountain, we are told that after one span of 1500 feet, the line "again makes a span of 1400 feet to an upper terminal 62,200 (*sic*) feet above the lower one." As the total height of Table Mountain is only 3600 feet, one wonders where in the heavens will be the "upper terminal" at 62,200 feet!

The section of the book relating to unloading and loading appliances is subdivided into appliances for discharging ships, as by means of skips, elevators, or by self-emptying boats, and for

* The Mechanical Handling of Material. By G. F. Zimmer. London: Crosby Lockwood and Son; 1905.

† See "JOURNAL," Vol. LXXXI., p. 551.

* See "JOURNAL," Vol. LXXXVIII., pp. 329 and 410.

unloading railway trucks. The Priestman, Hone, and other grabs naturally are fully described; and under the heading of "Hydraulic Grabs," an extract is given from a paper by Mr. Charles Carpenter,* who is designated as the "Deputy Chief Engineer of the South Metropolitan Gas-Works." About the discharging of railway trucks, little need be said here, for the matter was recently touched upon in the "JOURNAL" of Nov. 8, 1904.† Then comes a lengthy chapter on unloading by coal-tips; and the various devices are well illustrated and fully described.

Reaching the "Miscellaneous" section, the advantages and drawbacks of different methods of automatic weighing are considered. The hopper weighing machines for coal, such as Ingrey's and Avery's, have the advantage of accuracy, but require a good deal of space; and the coal has to be broken to a fairly uniform size. Continuous weighers, like Blake Denison's, do not give such an accurate record, but make little dust and require small headroom. Then there are intermittent weighbridges, automatic in character (like Avery's), and also adapted to record automatically the weight of passing goods on aërial ropeways.

Next, we turn to Chapter XXVII, headed "Coal-Handling Plant for Gas-Works, &c.," hoping to find some adequate and consecutive history of the many installations in existence. But we are again disappointed, for, of the plants in England, only two are mentioned; and these can scarcely be regarded as representative in any way—being those at Bristol and Brentwood. The Paris exhibition model, exhibited by a German firm, of coal-handling plant is fully described and regarded as "an ideal installation for mechanically handling coal and coke in gas-works"—a pious opinion, which may be taken for what it is worth. Continental or foreign plants have greater attention shown to them (as throughout all this book); the coal plants at the gas-works at Darmstadt, Nuremberg, Winterthur, Berlin, and Zurich being described—the last two more particularly as regards coal receiving by high-level cranes, such as the Temperley system, which is dealt with in the last chapter of the treatise.

We have thus cursorily run through the book; and it now only remains for us to comment on its style, and to summarize our impressions. Its letter-press is arranged in short paragraphs, apart from any consideration of the subject-matter dealt with. This retards the facility of fluent reading, without having, as it seems to us, any compensatory advantages. This cutting-up of the text is further increased by the numerous illustrations, which sometimes have to be looked for even 18 pages or more ahead of the printed description of them, which certainly does not conduce to easy reference. There are several repetitions, some grammatical errors, and printers' mistakes. The author is particularly fond of splitting his infinitives; and his facts are not always unimpeachable. We fully recognize and very heartily commend the patience and industry which such a bulky compilation must inevitably entail, and certain of its tables and descriptions may prove of use to some engineers in search of information and ideas, when extending or adopting labour-saving machinery. But it is all the more on this account that we regret the serious omissions in the work, some of which have already been noted. The exceedingly sparse mention of British gas engineers and plants, some of whom and of which are of world-wide celebrity, is to be regretted in the interest of the author, the book, and its readers alike. The impression created, judging more particularly by the gas-works' portion of the treatise, is that of a technical scrap-book, with a lot of the best scraps left out. We can only hope, as we believe, that Mr. Zimmer has treated the grain industry in a far fuller and more catholic spirit than he has the gas industry; and when a second edition comes to be required, we trust that some of the defects and omissions to which we have thought it our duty to call attention, will be remedied, and the consequent value of an important work thereby greatly enhanced.

* See "JOURNAL," Vol. LXXIII., p. 1557. † *Ibid*, Vol. LXXXVIII., p. 402.

The Gas-Turbine.

In a comment on a paper by Dr. Charles E. Lucke, entitled "Practical Investigations in the Gas-Turbine Problem," the Editors of the "Engineering Magazine" say: "The gas-turbine has been regarded as the logical successor of the steam-turbine, and already numerous devices have been produced, on paper, to convert the energy of the confined products of combustion into mechanical power. Dr. Lucke examines the thermodynamic principles involved in such devices, and shows, as the result of exhaustive experiments, conducted in the mechanical laboratory of Columbia University, that this conversion is not effected by free expansion in simple nozzles. A portion of the potential kinetic energy developed by the combustion, and readily transformed into work when the products of this combustion are allowed to expand in the cylinder of a reciprocating engine, is not so recovered when these same products expand through the nozzles of an ordinary turbine; and the difference is so great as to make the latter a failure commercially. This Dr. Lucke considers the answer to the question; and it is as definite as it is unfavourable. It refers, of course, wholly to the gas-turbine. The investigations do not cover a mixture of combustion gases and steam. An examination of the principles of free expansion, as discussed in this paper, will go far to prevent mistaken claims from receiving unwarranted support, and to direct the work of engineers and inventors into those channels in which success is more probable."

THE GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 319.)

THE Stock Exchange reopened on Tuesday very languidly, and business was extremely quiet; there being but a thin attendance. The tone was decidedly dull—a tendency which continued persistently. A feeling of nervousness, not entirely accountable, prevailed and hindered anything like enterprise. The uncertainty attending the belligerent fleets in the China seas, the Morocco difficulty, and the seething discontent in the Russian Empire, coupled with some degree of recent over-speculation, combined to induce operators to moderate their commitments. Thus prices all round were easier almost daily, though just at the close things were better than at the worst. The settlement happily brought about no difficulties, so far as is apparent. In the Money Market, there was a good, steady demand for the Stock Exchange and other requirements, and rates kept stiff. The course of the market in the near future seems very uncertain, and it is quite on the cards that the persistent prophets of a 2 per cent. rate (whose wish is father to their thought) will have to wait some time for the realization of their hopes. In the Gas Market, business was very quiet—a great falling off from the form of recent weeks; and the tendency was no better than moderately steady. Perhaps it suffered from holiday interruptions; the Exchange being closed not only on Easter Monday, but on Monday the 1st of May. There were, however, very few actual changes in quotation, issues in general "marking time" for the most part. In Gas-light and Coke, the ordinary stock was rather weaker, and did not receive much support. The opening price was 97¼, from which level the figures shrank to a bargain at 95½ on Friday, recovering at the close to 96½. The secured issues were little dealt in. The maximum marked 92¼, and the preference from 109 to 110. South Metropolitan was quiet also; but was fairly steady. The marked prices ranged from 127⅛ to 128⅜. A single transaction in the 4 per cent. at 115 was all the business in Commercials. The Suburban and Provincial group were never quieter. Brentford debentures changed hands at 107¾, West Ham ordinary at 102⅛ and 103, and ditto preference at from 123½ to 124⅜. On the local Exchange, Liverpool "B" had a fair rise, and Shrewsbury a larger one of four points. The Continental Companies were negatively conspicuous—not a single transaction being recorded in any one of them. Among the undertakings of the remoter world, Monte Video changed hands at from 11⅞ to 12¼, River Plate at 13 and 13⅜ *cum div.* and 12¾ *ex div.*, and ditto debenture at 98. San Paulo marked 12$\frac{13}{16}$, Primitiva ordinary 6⅛ to 6$\frac{7}{16}$ *cum div.* and from 6⅛ to 6¼ *ex div.*, ditto preference 5⅛ and 5¼, and ditto debenture from 97¼ to 98. In Melbourne 5 per cents., business was done at 101 and 102¼, and in ditto 4½ per cents at 102½.

The closing prices are shown in our Stock and Share List at page 319.

NEWS OF THE OSMIUM LAMP.

THE honour due to Baron Auer von Welsbach from the gas industry renders of considerable interest to those professionally engaged in it, his work in connection with the osmium electric lamp, apart from what should perhaps rank as the primary ground of interest—the expectation of this great laboratory worker that this lamp was going to place in the hands of the electrical industry a potential weapon with which to fight for supremacy the inventor's own incandescent gas mantle. Had the Baron been as successful with the osmium lamp as with the gas mantle, the competition between his progeny might have ended in one or the other having to be branded a fratricide; but the domestic felicity is not likely to be disturbed, seeing that, although it has been carefully tended for six years, the younger of the offspring is but a weakling of which the gas mantle does not go in fear. It is six years since Baron Auer von Welsbach "invented" the osmium lamp; and he has worked at it ever since, with results that rather disgusted some of the supporters of the old Welsbach Company. And the opinion that the present Company held—and which led them to sever the Company's tie with extremely problematical prospects—as to the lamp eventually coming out as a successful commercial article, appears to be very much the opinion of the electrical world to-day. The latest information to be found about the osmium lamp is in a paper read, before an electrical society in Berlin, by Herr Fritz Blau—an abridged translation of which has appeared in the "Electrician." The paper, it may be taken, is intended to be complimentary to the inventor and the lamp; but to many people it will offer all the evidence required that the osmium lamp is afflicted similarly to the tantalum lamp, of somewhat like lineage, which was recently noticed in the "Electric Lighting Memoranda."

Osmium, we are told, in the paper is brittle when cold, and soft when heated; and for this reason the lamps as made at present are required to burn in a definite position. These are the reverse of commendable features; and in them will be found sufficient grounds for the author stating that, when exposed to hard shocks, the osmium filament is somewhat more liable (this is putting it mildly) to break than the carbon filament, and for the inventor

having failed to make wires of the fineness required for high-pressure lamps. But there has been improvement in this regard. There was a time when the highest pressure the lamp could endure was 27 volts; and this has slowly crept up to 55 and 73 volts. Quite recently, too, 110-volt lamps have "appeared;" but we are not enlightened as to what happened after their appearance. It may be of interest to learn that the filament of an osmium lamp for 37 volts, 25 Hefner candles, consuming 1½ watts per candle power, has a diameter of 0·087 mm. and a length of 280 mm. The radiating surface of it is from 3 to 3·2 sq. mm. per candle power. Herr Blau states that it is not possible to speak definitely of the life of an osmium lamp; but 5000 hours have been "repeatedly exceeded." We should very much like to know something about the candle power at the end of that period, inasmuch as there is included in the paper two diagrams showing, in the one case, the percentage variation in candle power of a 37-44 volt 25-32 Hefner candle lamp, and of a 110 volt 32 Hefner candle lamp; and we judge from these that, after the first 250 hours, the decline in the illuminating value is constantly proceeding. Up to (say) 250 hours, the candle power increases; this being due to the surface of the filament being at first somewhat rough, and then gradually becoming smoother.

In the discussion on Herr Blau's paper, we are asked by Professor Wedding to believe that the blackening of the bulbs of ordinary carbon filament lamps has no marked effect in diminishing the candle power. It will be generous to think the Professor is a bit of a wit.

PERSONAL.

At the meeting of the Institution of Electrical Engineers last Thursday, Dr. R. T. Glazebrook, F.R.S., Director of the National Physical Laboratory, was nominated for the office of Vice-President.

In the "Journal" for the 11th ult., it was mentioned that Mr. E. J. Brockway, the Engineer and Secretary of the Cleethorpes Gas Company, had been elected a member of the District Council. We are pleased to find that, at the recent annual meeting of the Council, Mr. Brockway was unanimously chosen as Chairman. In noticing the appointment, a local paper referred to the new Chairman's keen business capacity in matters he had taken in hand, and expressed the opinion that under his guidance the town might expect a continuance of the policy which had done so much for it. Mr. Brockway has since been made a Justice of the Peace.

OBITUARY.

LORD GRIMTHORPE.

In the early hours of last Saturday, there passed away, within a few days of celebrating his 89th birthday, one who for many years defended the cause of gas and water companies in the Committee-rooms at Westminster. After a short illness, brought about by a fall, Edmund, first Baron Grimthorpe, died at his seat, Batch Wood, St. Albans, of heart failure. He was born on May 12, 1816; his father being Sir Edmund Beckett, who assumed the name of Denison in 1816, but returned to that of Beckett on succeeding as fourth Baronet in 1872. He was educated at Eton, and went up to Trinity College, Cambridge, which he left as 30th wrangler in 1838. He was called to the Bar at Lincoln's Inn in 1841, and took silk in 1854, when he began to be a conspicuous figure at Westminster. Mr. Denison was one of a brilliant group of advocates which contained such men as Wrangham, Sargood, Burke, Hope Scott, Webster, Vaughan Richards, and Michael; and in 1858 he was associated with two of them—Wrangham and Hope Scott—as his leaders on the Nottingham Gas Bill. Two years later he himself led in the inquiry before Mr. Sotheron Estcourt's Committee on the Metropolis Gas Regulation Bill. From that time onwards his exceptional ability as an advocate had plenty of scope for its display. As Mr. Denison, he was leader on the Imperial Gas Bill in 1873; but on succeeding to the fifth baronetcy the following year, he took the name of Beckett. It was as Sir Edmund Beckett that he led on the Birmingham Gas Bill in 1875, having Michael and Dugdale with him. He was retained by the London Water Companies on the occasion of the inquiry before Sir William Harcourt's Committee in 1880, when the scheme submitted by Mr. E. J. Smith for dealing with the undertakings was subjected to so much criticism to so little purpose; and next year he led on the South Metropolitan Gas Bill. He was created a Baron in 1886 and withdrew from practice. He for some years filled the position of Chancellor and Vicar-General of York, held the degree of LL.D., and was a Justice of the Peace. Lord Grimthorpe was a many-sided man—a shrewd lawyer, a caustic critic, a keen controversialist, an amateur architect and clockmaker, and a thorough-going Protestant Churchman; and he did not fail to exercise his talents. He had almost a mania for the restoration of old ecclesiastical buildings; and his work at St. Albans Abbey since 1878, whatever opinions may be held as to the appropriateness of some of it, will always be a monument to his assiduity and munificence. As is pretty generally known, Londoners are indebted to him for the great clock and bell which mark the passing hours in the Legislative Palace where their designer achieved so many successes of an altogether different character. Of late years he had spent most of his time at St. Albans, under the shadow of the sacred edifice which was the object of so much devoted attention; and by all connected with it, as well as by the townspeople generally, his venerable figure will be greatly missed, and his memory fondly cherished.

The death of Alderman John King, which took place last Tuesday afternoon, removed a representative of one of the oldest and most respected of Manchester families, and a conspicuous figure in all movements having for their object the welfare of the city. He was a member of the firm of Messrs. Wadkin and King, sewing-cotton manufacturers, and he entered the Council to represent the Oxford Ward in 1856. In 1867 he was appointed an Alderman; and in 1874 was elected Mayor. In the arduous work of the Committees of the Council he took a considerable share. He was for some time Chairman of the Gas Committee, but relinquished this position in order to take the chairmanship of the Finance Committee, which he held till failing health kept him from public duties. He also did a good deal of work on the Water Committee. He was the "father" of the Council; and his ability, energy, and devotion to his duties were fully appreciated by all his colleagues, and secured for him their warmest esteem. The deceased gentleman was 86 years of age, and he leaves four sons and a daughter. The funeral took place on Friday.

From Early Volumes of the "Journal."—Sept. 10, 1851.

It may be recollected that some time ago a spring of mineral oil, like those in Persia and other countries, was found in a mine in Derbyshire. On distillation, it was ascertained to be an oil of great value for the lubrication of machinery, and was much used for that purpose in Manchester; but the supply ceased. The attention of Mr. Young, of that town, was then directed to the subject. From its connection with the coal district, he believed that it might be produced therefrom by chemical means. The naphtha produced by the distillation of coal differs entirely from that found in the natural spring referred to. Mr. Young, however, has discovered a process by which he entirely converts the volatile principle of coal into a liquid oil, and into a substance called paraffine. This substance had never previously been produced from coal, though it had from the distillation of wood. If paraffine be heated, it is converted into olefiant gas—the illuminating principle of the ordinary gas which lights our streets and houses. It may, therefore, be appropriately termed "solid gas." The oil produced is also paraffine in a different condition; and thus Mr. Young, by distilling coal at a low heat, has succeeded in producing solid and liquid gas. The importance of this discovery was pointed out by Baron Liebig in a recent work, wherein he describes the solidification of gas as one of the greatest wants of the age. Mr. Young has produced the desired result by a process preliminary in its stage to that hinted at by the great chemist; and in weight the results obtained by him tally exactly with what they would in the manufacture of common gas. In practice nothing can be more simple than this discovery. The coal introduced at one end of a retort is screwed out in the form of coke at the other; while the liquid and solid products of distillation come away from a separate opening. If successfully carried out on a large scale, Mr. Young's process will yield very important results, and among these may be specified the economical production of coke for our railways, in the manufacture of which vast quantities of gas are now entirely wasted.—*Times*. [It is understood that this process consists in the long distillation of coal at very low temperatures. A large manufactory has been established at Bathgate, near Edinburgh, where the Boghead cannel coal is thus treated, and very valuable products obtained.]

A defective reservoir has been causing the Water Department of Shippensburg (Pa.) considerable trouble, according to "Engineering Record." It was built in 1903-4, beside an old reservoir dating from 1886. The bottom and slopes of the latter were puddled by the contractor; but when the water was turned into the basin, it leaked out in a very short time. Repairs were made, including repuddling; but the water broke through when it was again admitted to the reservoir. The interior was then planked; but this proved unsatisfactory. The new reservoir is lined with concrete 9 inches thick, laid in slabs, with the joints filled with asphalte. When the excavation was made, a number of holes and chambers were discovered in the rock on the bottom and slopes, which were filled with stone and concrete. The asphalte did not adhere well to the concrete slabs, and apparently allowed the water to leak through the joints into the fissures below. The concrete cracked in many places on the slopes, and the cracks were cut out and filled with asphalte. When the basin was filled, the lining failed at two corners and on the bottom. The alternate filling and repairing were repeated four times; and finally, when there was 12 feet of water in the basin, one side went out from the crest to the bottom. At this place, the ground is a soft soapstone clay and rotten soapstone. The water leaked through this material to the bottom of the hill, where it came to the surface and entered a small brook. Mr. B. F. Landis, the Superintendent, who furnished this information to our contemporary, attributes the failure to the unsatisfactory character of the joints between the concrete slabs.

STREET PHOTOMETRIC TESTS MADE AT TEDDINGTON BY THE NATIONAL PHYSICAL LABORATORY.

By Clifford C. Paterson, Assoc.M.Inst.C.E.

A brief account of some photometric measurements made on street-lamps was recently given in No. 11 (Vol. 1) of "Edmondson's Monthly." As the National Physical Laboratory has received several enquiries with reference to these measurements, they have obtained permission from the Surveyor of the Teddington Urban District Council to publish the results, together with some data concerning the amount of gas and electricity taken by the various lamps under test.

The conditions of the test were as follows: Two streets in Teddington had been equipped with gas and electric lamps respectively. The gas lanterns were fitted with single "C" burners consuming nominally from 4 to 4¼ cubic feet of gas per hour, and having the ordinary type of incandescent mantle. The electric lamps were of the Nernst vertical filament "A" type and Nernst "Luna" type, both taking nominally ½ ampere at 240 volts—viz., 120 watts.

The photometric measurements do not purport to give a complete illumination contour of the street; the two systems being compared in terms of the illumination produced by each on a horizontal surface placed 7 feet away from the centre-line of the lamp-post, and 5 feet above the ground. In order to insure that this test was a fair one on which to found a comparison, measurements of illumination were made at greater distances from the lamp—up to 20 feet; and it was found that the relative falling off in illumination with distance was only about 5 per cent. more in the the case of the "Luna" lamps than with the gas-lights. Measurements were made on the gas-lamps for three nights in succession; the electric lamps (owing to greater constancy) being photometered twice only. The results obtained were as follows, each value representing the mean of several readings taken round the lamp in question:—

Gas-Lights.

	June 9. Candle Feet.	June 13. Candle Feet.	June 16. Candle Feet.
Lamp No. 1	0·335	0·270	0·172
Lamp No. 2	0·228	Mantle broken	0·273
Lamp No. 3	0·335	0·205	0·320
Lamp No. 4	0·202	0·240	0·245
Average values	0·275	0·238	0·253

On June 9, the mantles had been glowing for two nights previous to the measurements, and on June 13 for six nights. On June 16, the old mantles were replaced by entirely new ones; the low average of 0·253 candle feet being due to the inferior illumination given by lamp No. 1.

Electric Lights

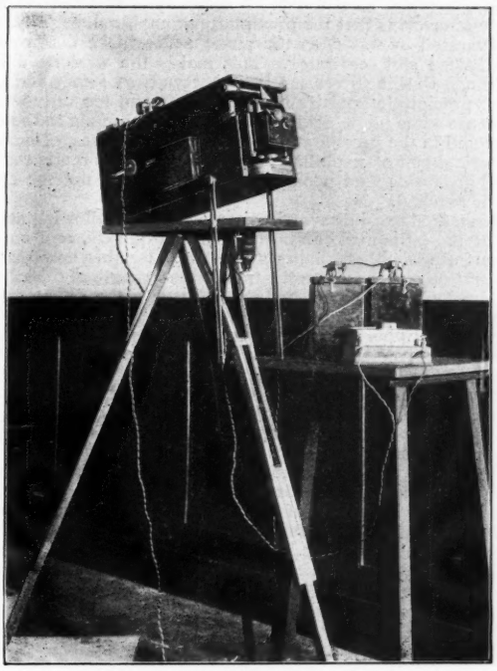
		June 9. Candle Feet.	June 13. Candle Feet.
Lamp No. 1	Nernst vertical filament type	0·460	0·470
,, No. 2		0·285	0·205
Average values		0·372	0·337
Lamp No. 4	Nernst "Luna" type	0·565	0·560
,, No. 5		0·675	0·660
Average values		0·620	0·610

If these results be used in the two cases, to calculate the amount of gas and electricity required respectively per candle foot illumination, the following figures are obtained and serve to compare the efficiency of the two systems:—

	Gas.	Electricity. Nernst "Luna."	Electricity. Nernst vertical.
Power consumption per lamp	4·12 cub. ft. of gas per hour.	0·12 unit per hour.	0·12 unit per hour.
Average illumination measured 7 feet from post and 5 feet from ground	0·25 candle foot.	0·61 candle foot.	0 35 candle foot.
Power required per hour to obtain ½ candle foot illumination at a point 7 feet from post and 5 feet from ground.	8·2 cub. ft. of gas per hour.	0·098 unit per hour.	0·17 unit per hour.

It may justly be urged that the measurement of illumination in the street at a point near the lamp is not necessarily a guide to the general illumination at points further away—due to reflection from surrounding buildings, as well as direct light from the lamp itself.

The authorities at the Laboratory regret that they were unable to continue the tests, with the object of making a more thorough illumination survey of the street. The object of the measurements, however, was attained in this case when, for the purpose of ensuring uniform duty from the lamps in future, a measure of their illuminating power should have been fixed upon as a standard. As already explained, however, measurements at greater distances showed fair equality in the falling off in illuminating power (on the footway) of the two systems; so that the results given may be accepted as a fair guide to a comparison between the efficiencies of the various lamps under test.



The Portable Photometrical Apparatus Employed.

The portable apparatus used in the tests is shown in the accompanying illustration. It consists of a box-photometer, mounted on a firm tripod stand; at the back of the box being fixed a 10-volt 2-candle electric lamp, which acts as a standard. The photometer shown on the front is one of the well-known Simmance-Abady "Flicker" type. Current is supplied by a portable battery of accumulators; and, by varying the voltage across the lamp, its candle power may also be varied over a wide range. It will thus be seen that the photometer head and lamp remaining fixed, it is simply necessary to calibrate the whole apparatus over the range of voltage of the lamp, obtaining a curve connecting voltage with illumination on the photometer screen.

The pressure on the lamp is measured by a precision voltmeter, which enables observations to be made with great accuracy—the variation in the candle power of the standard lamp being made by means of a continuously adjustable resistance in series with it, and placed conveniently to the hand of the observer. The apparatus was standardized at the Laboratory each evening before measurements were made; but no change in the calibration was observable throughout the tests.

ESTIMATION OF NAPHTHALENE IN COAL GAS.

A SIMPLIFICATION OF THE COLMAN AND SMITH METHOD.

By C. J. H. Madsen, Chemist of the Eastern Gas-Works, Copenhagen.

In the "Journal" for March 27, 1900, the method devised by Dr. Colman and Mr. J. F. Smith for estimating naphthalene in coal gas was fully described. Briefly, the plan is this: The gas is made to pass an aqueous solution of picric acid, by which appears a crystalline precipitate, of the formula $C_{10}H_8$, $C_6H_2(NO_2)_3.OH$—viz., naphthalene picrate, a chemical compound of equal molecules of naphthalene and picric acid. One part of the naphthalene, however, separates as naphthalene without combining with the picric acid; and therefore the liquid containing the precipitate has to be heated in a vacuum in a water-bath, in the manner indicated by Mr. F. W. Küster. The liquid containing the precipitate will then become quite clear; but all the naphthalene will on the subsequent cooling separate in a form like the before-mentioned crystalline naphthalene picrate. The precipitate is now filtered away and washed with a little water, and the filtrate titrated with decinormal sodium hydrate, using lacmoid as an indicator.

It is, of course, provided that the gas is freed of the ammonia before it passes the picric acid—*e.g.*, by passing a solution of citric acid or oxalic acid; or, the quantity of ammonia in the gas being known, it is calculated how much picric acid is consumed for

saturating the ammonia. As india-rubber readily absorbs naphthalene, it is further of great importance to observe the circumstance mentioned by Dr. Colman and Mr. Smith in the "JOURNAL" for Aug. 14, 1900—namely, to avoid most particularly the gas passing an india-rubber pipe before leaving the picric acid. Glass pipes must therefore be used; rubber being only employed for the actual joints—the ends of the tubes thus joined being placed as close together as possible. A difficulty of this method, and a source of error, is that the precipitate of naphthalene picrate can be separated by water, as the picric acid will be dissolved, the naphthalene still remaining. This makes the washing difficult. Too much washing gives too small a result, as some picric acid of the precipitate appears in the filtrate; and too little washing will cause some picric acid of the solution to remain in the filter-paper and in the precipitate, and the analysis gives, of course, a greater amount of naphthalene in the gas than is really the case. It will always depend upon judgment whether or not the correct limit is reached.

The method can, however, be simplified in the following manner, so that the estimation can be made more quickly, and anybody can operate it without being a chemist. By this new plan, the the titration and the determination of the strength of the solutions combined with it are avoided; and likewise the difficulty mentioned, of the separation of the precipitate by water. In certain analyses where perfect accuracy is not demanded, it is known that the centrifugal method is used, so that a precipitate, together with the liquid in which it appears, must be treated by the centrifugal method in a vessel made for the purpose, and divided in order to read the volume of the before-mentioned precipitate—*e.g.*, the determination of phosphorus, by which the yellow phosphorus molybdate is measured, of urine, cellulose in fodder, &c.

I have tried to apply the method to the precipitate of naphthalene picrate; and it has proved very applicable. The centrifugal apparatus used was one of the well-known small arrangements of Herr R. Katter, of Berlin (see fig. 1). The vessel was divided into $\frac{1}{10}$ c.c. The reading becomes more accurate from a vessel the lower part of which is cylindrical, but of smaller section.

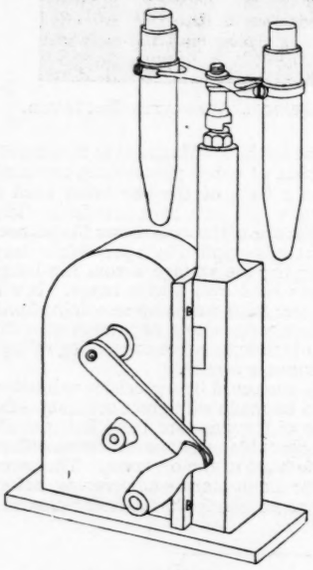


FIG. 1.

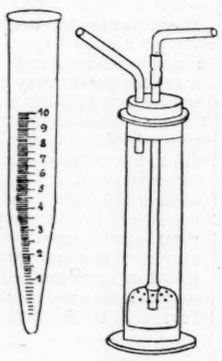


FIG. 2.

The determination of naphthalene is then made as follows: The type of bottle indicated by Herr Drehschmidt, and shown in fig. 2, is recommended. It is also applicable for other gas analysis, as the washing then is very simple. A cork covered with paraffin must be employed. In such a bottle is placed 50 c.c. of a 1 per cent. solution of picric acid; and the gas is led through at a velocity of about 2 cubic feet per hour. If the gas contains much naphthalene, two bottles for absorbing should be used, one after the other, each of them containing 50 c.c. of picric acid.

If there is much ammonia in the gas, a similar bottle, containing a solution of citric acid, must be used before the bottle with picric acid. From the absorption bottle the gas is led to the meter, and then away. If required, a pump must be used for suction. The quantity of gas dealt with is 10 cubic feet. Then follows the heating in vacuum, as already mentioned. This can be avoided without greater error, if the result is raised 9 to 10 per cent. (gas containing much naphthalene perhaps more). According to my experiments, the error will only be $\pm$ 3 per cent.

The precipitate is now made to settle; and then the clear liquid on the top is removed, and the rest, containing the precipitate, poured into the vessel of the centrifugal apparatus. If the precipitate does not easily settle, the whole liquid can be gradually poured into the vessel of the centrifugal apparatus; and for every filling up this is slung round, and the clear liquid on the top is removed, &c. By this centrifugal method, the precipitate will occupy a quite constant volume when the handle has been turned twenty times at a velocity of eighty times a minute. The centrifugal apparatus then makes about 1760 revolutions a minute, as the gearing is 1 : 22.

In a great many analyses, the centrifugal method has been compared with that of titration; and the comparisons have given the following results: If during the experiment 10 cubic feet of gas have passed the picric acid, and the precipitate in the centrifugal apparatus is measured, 1 c.c. of the precipitate will correspond to 3·33 grains of naphthalene in 100 cubic feet of gas. If in this manner 10 cubic feet of gas give 2·3 c.c. of the precipitate, the gas then contains $3{\cdot}33 \times 2{\cdot}3 = 7{\cdot}7$ grains of naphthalene per 100 cubic feet. It must, however, be observed that the same liability to error which attends the method of titration on account of the above-mentioned difficulty in washing is, of course, to be found in the number 3·33.

In the analysis of titration in question, the washing in all cases is made in the same manner. There must also always be a doubt as to the absolute accuracy of the numbers. But relatively the centrifugal method will give good results; and this, as a rule, being probably the main point, and the determination being quick and easy to execute, I have thought the method described above would be of interest to readers of the "JOURNAL."

STATUTORY ILLUMINATING POWER.

By H. LEICESTER GREVILLE, F.I.C., F.C.S.

The question of the best—one might hardly dare to say the most "honest"—way to determine the illuminating power of the public gas supply has been such a grave matter of consideration, and the deliberations on the question have extended over so long a period, that it would almost seem finality was as unapproachable as ever. The question of a compromise between those who manufacture and supply gas to the public and the guardians of the public interest ought not to be difficult. Any legislation is, however, more or less of a compromise; but the difficulty is mainly that of conciliating opposing parties.

Putting the question in the simplest possible manner as a matter of practical science and common sense, there are only two courses open in dealing with different grades of gas on the point of illuminating power: (1) A special burner for each quality of gas (at possibly a definite consumption); and (2) a burner available for all grades of gas with a varying consumption. I think the latter course is the best. I have advocated this in previous articles with special reference to the Sugg "London" argand.

It is so thoroughly understood, or should be, that the proper development of light from illuminating gas depends on the ratio of the respective amounts of gas and air supply (minor considerations being omitted), that it is simply astounding that the question should still need further discussion, and of surprise that such a practice should be advocated as that of burning all qualities of gas at a 5 cubic feet rate in the "London" argand. It is a matter of congratulation to learn that the gas companies are for once united in their protest against such an iniquitous and unjust proposition. The compromise suggested as affording the companies the advantage of a mean of three days' testing is nothing to the point. A system of testing which is unjust on one day would not diminish its injustice by being extended to three days. Further, if 14-candle gas would, by the projected system of testing, be reported as 13-candle, and this allowed as a statutory requirement, the public would simply consider that the gas company had lowered the quality of their gas, being in absolute ignorance that the difference was not due to the gas, but to the adoption of a different system of testing.

This question of the proper determination of illuminating power is most vital to the gas companies; and they are evidently aware of it. It is the most important of all the questions raised in the fresh proposals for modern legislation.

With regard to sulphur purification, it seems to be taken for granted that an abrogation of penalties for the presence of "sulphur compounds other than sulphuretted hydrogen" will mean the disuse of lime purification. This does not follow as a sequence. It is still an open question whether it will not pay a company, on the ground of the maintenance of illuminating power, to remove carbon dioxide from their gas. Oxide of iron can be used first for the total elimination of sulphuretted hydrogen, and lime last for the more or less complete removal of carbon dioxide. The spent lime is then so far inoffensive that on discharge it has only the usual ordinary odour of gas. This process of working has been employed by many provincial gas companies for some years; and the only objection I have ever heard raised to it is that of excessive back-pressure. This trouble could, of course, be met by the use of thinner layers of material or by having a larger purifier area. The use of lime in this manner has a further advantage —viz., that complete elimination of the carbon dioxide is not necessary; whereas under the old *régime*, where sulphur compounds had to be considered, the least trace of the impurity going forward would give rise to serious complications.

It is quite within the province of predication that the use of lime may be abolished by the substitution of the more scientific employment of gas liquor as a means of purification. Much has already been done in this direction; but the question has not yet reached finality, and there is no reason why complete success should not be accomplished as the result of further investigation and experience.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

Half-Yearly Meeting in Newcastle.

The Association held their Fifty-Sixth Half-Yearly Meeting in the County Hotel, Newcastle, on Saturday—Mr. E. E. J. ANDERSON, of Middleton, presided. There was a very good attendance.

REPORT OF THE COMMITTEE.

The HON. SECRETARY (Mr. Herbert Lees, of Hexham) read the report of the Committee, to the following effect:—

Your Committee have, during the past year, had under consideration several questions of more than ordinary importance; and they now beg to submit to you the result of their deliberations.

Technical Instruction in Gas Manufacture.—In conjunction with the larger Committee appointed to deal with this work, they have again co-operated with the Council of Rutherford College, and have made an appeal to the gas undertakings for funds in its support, with the result that £18 16s. has been received. This amount has been paid over to the Rutherford College authorities. During the session, the class has been attended in the ordinary and honours grade respectively; and altogether 28 pupils have attended the two classes. The examination takes place this [Saturday] afternoon.

Affiliation of District Associations with the Institution of Gas Engineers.—This scheme has now been carried to a successful issue; and your Committee have, in accordance with a resolution passed at the general meeting twelve months ago, affiliated the Association with the Institution of Gas Engineers. This entitles the Association to a representative on the Council of the Institution; and, as it was necessary to make the nomination of such representatives at least fifty days before the annual meeting of the Institution, your Committee have nominated Mr. F. P. Tarratt for this office for the ensuing year, and hereby ask you to confirm the selection.

Naphthalene Question.—A circular has been issued by the Southern District Association of Gas Engineers and Managers, to the various District Associations, asking that an appeal be made to the gas undertakings in their respective districts for funds to continue the experiments that are being conducted by the Southern District Association. Your Committee have adopted the following resolution thereon: "That, in the opinion of this Committee, such an appeal as is suggested would come with greater force if made by the Institution of Gas Engineers."

"*Question-Box*" *Proposal.*—This subject has also been under the consideration of your Committee; and it has been decided not to take any action until the proposals are further matured.

On the motion of the PRESIDENT, seconded by Mr. MATTHEW LEAF, of York, the report was adopted, and the nomination of Mr. Tarratt was approved of.

NEW MEMBERS AND ASSOCIATES.

The following were recommended by the Committee for election to the Association:—

Members: J. C. Angus, of York; George Lamb, of Heaton, Newcastle; Richard Lockey, of Morpeth; and W. F. Winpenny, of Tudhoe. *Associates:* W. Carmichael Peebles, of Edinburgh; W. J. Jenkins, of Retford; and Harry J. Smith, of Shotley Bridge.

They were unanimously elected.

Mr. JOSEPH CHISHOLM, of Hull, read the following paper:—

IMPROVED WORKING RESULTS BY A RATIONAL TREATMENT OF THE HYDRAULIC MAIN SEAL.

The primary object of the hydraulic main is to form a self-acting valve with the dip-pipe. The part played by the hydraulic main in the economics of gas manufacture has been such a quiet one until this last few months that, in a great measure, it appears to have been in many works considerably overlooked. I have no intention of entering into the question of whether the hydraulic main is a necessity or not. It has, I know, in certain works been abolished altogether, and some type or other of anti-dip or dry main arrangement put in. I must confess that, personally, I have a preference for the hydraulic main and dip-pipe.

It is just over three years ago that I was appointed to my present position with the Sutton, Southcoates, and Drypool Gas Company. On commencing my duties, the first matter I had to deal with was the make of gas per ton of coal carbonized, which, as well as the make per man per shift, was very unsatisfactory from the class of coal in use—best South Yorkshire Silkstone. On examining the two retort benches and fittings, I found the heats were very good, but whenever charging was in operation dense volumes of black smoke were given off from the chimney-stack. The conditions of the retorts were very fair; and the only conclusion I could arrive at for the moment was that there must be some back-pressure given somewhere.

In the engine-house, the recorder showed 30-10ths vacuum on the inlet of the condensers, and in the retort-house 26-10ths. I then determined to systematically test the seals on the dip-pipes throughout. On the generator settings—of which there are six beds of through retorts to one length of hydraulic main—I found that there was 1 inch of seal with 26-10ths vacuum in the retort-house, and this seal was fixed. (See fig. 1.) The tar was run off every twenty-four hours; and I was satisfied for the time being that no air was drawn in, and the seal valves were as low as they could be got. The next thing to be done was to test the seal on the regenerator settings, of which there are six beds of through retorts—two beds to each length of hydraulic main. The seal-valves were all set alike; being 3½ inches up, and giving a seal of 4½ inches. (See fig. 2.)

No doubt you will wonder what the wooden trough is for. It was a temporary arrangement used as a tar take-off. I learned that at one time the tar was run off only once in seven days. Of course, the trough was done away with during the following summer, and a suitable tar take-off main put in. I lowered one valve as far as it would go—that is 3½ inches—took 10-10ths

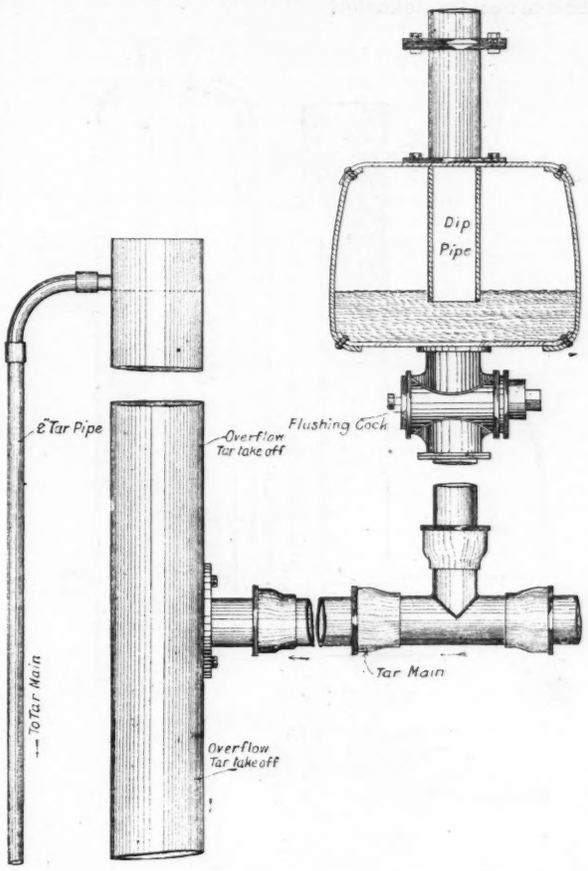


FIG. 1.—DETAILS OF THE TAR TAKE-OFF—GENERATOR SETTINGS

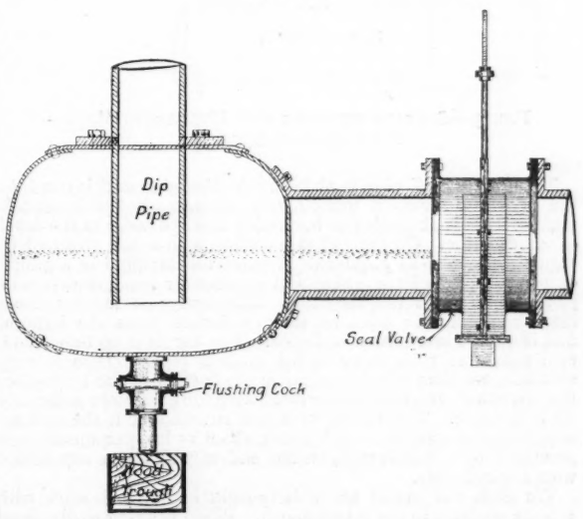


FIG. 2.—SECTION OF ORIGINAL TAR TAKE-OFF—REGENERATOR SETTINGS.

vacuum off at the engine-house and tried the seal, only to find that there was still 1 inch seal. But this was a great relief. The remainder of the valves were then lowered. The chimney was now clear of smoke; and in the next shift the make of gas per man per shift increased about 4000 cubic feet, and the make per ton increased at the same time.

We continued working under these better conditions until last summer, when the subject of tar take-off systems appeared in our technical journals. I thought the success of the appliances there advocated depended too much upon the stokers or someone else having to work them. It appeared to me that some more simple, effective, and cheap arrangement could be devised; and I drew the attention of our Engineer and Manager (Mr. John Holliday) to this idea. (See fig. 3). After discussing it thoroughly for and against, he came to the conclusion that it was a step in the right direction, and ordered six to be fixed on the regenerator settings. We had the first set put to work in July, as we commenced to light up the settings. The connections are very simple, as will be seen from the illustration.

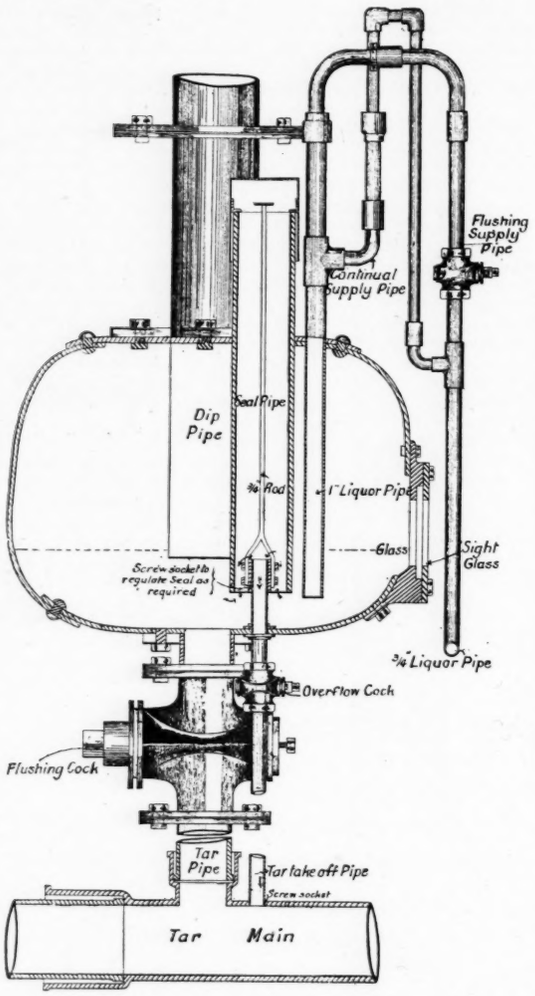
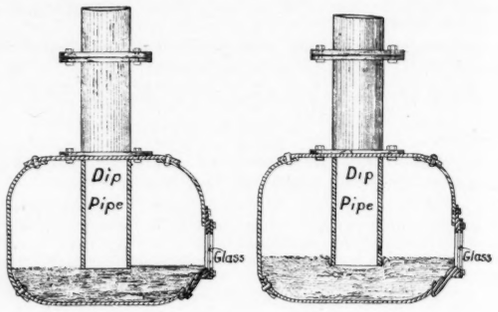


FIG. 3.—SECTION THROUGH THE HYDRAULIC MAIN—REGENERATOR SETTINGS.

The tar take-off pipe is 1¼ inches in diameter, and is run into the ordinary tar-main immediately underneath the hydraulic main. It rises through the bottom of the hydraulic to the level of the dip-pipe. On the end is a socket, with a rod attached to regulate the seal as required. Around the tar-pipe is a 3-inch cast-iron pipe, to form a seal and prevent air being drawn in or gas escaping into the tar-main. This seal pipe reaches down into the hydraulic main to some 2 inches from the bottom, and is sealed in 2 inches of liquor. The tar rises up this 3-inch seal pipe, and runs away in the 1¼-inch pipe. There is very seldom more than 2 inches of tar in the bottom of the hydraulic; the continual stream of liquor displacing the tar almost as quickly as it is made. The supply of liquor is taken from the column supplying the scrubbers (it is under about 15 lbs. per square inch pressure) by a ½-inch pipe, on the end of which is a cap drilled with a ⅛ inch hole.

We flush our mains every forty-eight hours, and work with 5-10ths vacuum in the retort-house. When running with a level gauge, we have a ¼-inch seal on the dip-pipes, and with 5-10ths vacuum the liquor rises in the hydraulic between ¾ inch and 1 inch. As there is some oscillation, it is almost impossible to get the actual level; while the liquor in the dip-pipe forms a concave (see figs. 4 and 5) of rather more than ½ inch in centre. This concave was found by putting in the search rod the proper depth in the centre of the dip-pipe. When it was withdrawn it was found to be quite dry, and on putting it in again (½ inch), it was still dry when withdrawn. On putting it in a further ¼ inch, however, it had just touched the liquor; and on looking at the sight glass, the liquor was seen to be about 1 inch up the outside of the dipe-pipe.



Liquor under Atmospheric Pressure. Liquor under Vacuum.

FIG. 4.—SECTION THROUGH THE HYDRAULIC MAIN—REGENERATOR SETTINGS.

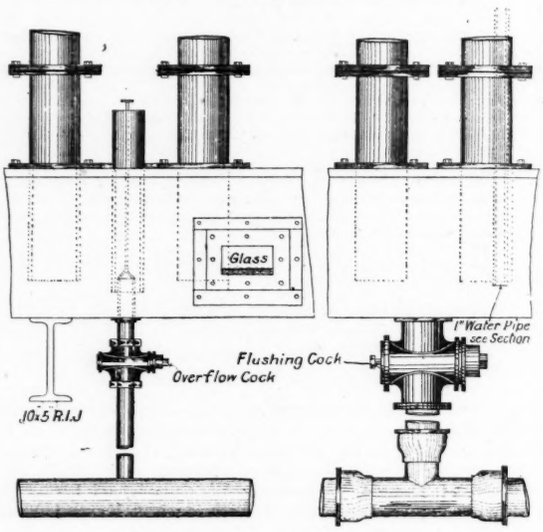


FIG. 5.—ELEVATIONS OF THE HYDRAULIC MAIN—REGENERATOR SETTINGS.

It is generally understood that a 1-inch seal on the dip-pipes with the exhauster running with level gauge is the right thing. In text-books, most writers say from 1 inch to 2 inch seal is for safe working. In "Self-Instrnction for Students in Gas Manufacture" (Elementary, Second Edition), p. 18, it says: "The dip-pipes are immersed in the liquid in the main to a depth of from 1½ to 2 inches, and the gas on leaving the retort travels up the ascension pipe, down the saddle to the dip-pipe, down which it passes, and, forcing its way through the light seal of the dip-pipe in the liquid, it emerges at the surface of the latter, when it passes to the condenser." In the "Question and Answers" column of the "Gas World" for Jan. 7 last, question No. 4 was: "Which is the better plan of working; with a 3-inch seal on the dip-pipes, and 2½-inch vacuum on inlet of exhauster, or ½-inch to 1-inch seal on the dip-pipes and level gauge at exhauster?" The answer was: "The heavy seal on the dip-pipes is objectionable, as likely to cause oscillation, which is one of the most active agents in the deposition of carbon; and therefore the usual practice is to reduce the seal to as little above atmospheric pressure as is safe and practicable." Personally, I do not think that these heavy seals are necessary for safe working, against a pressure of (say) 24 inches—that is, in case of the exhauster engines stopping, and gas coming back into the settings and causing an explosion. If I had reason to be afraid of the engine stopping suddenly, I would suggest the putting in of a light flap-valve on either side of the exhauster. This would tend to check the back-flow of the gas.

Since we have worked with this light seal, there has been very little deposit of carbon in the retorts; and as regards stopped ascension pipes, it is practically a cure. We scarcely know what a stopped pipe is on the regenerator settings, and we have high heats. Our increased make of gas per man per shift for the two months of January and February of the current year averaged 1546 cubic feet over the corresponding months of last year. The increased make of gas per ton of coal carbonized is 771 cubic feet. The total cost of one set, including the fixing complete, is £3 18s. 11d.

In asking your indulgence for the incomplete nature of this paper, I wish it to be clearly understood that it is not intended as a technical contribution, but plain facts as they have been

observed daily. It may not be an ideal system of engineering; the main thing in my opinion is that it does its work satisfactorily, and it is not at all times that we do as we would like to do, but have to do as we can under existing conditions. There is nothing about the system that may be claimed as new; it may be at work at many places, for aught I know. I would like it to be borne in mind that ½ inch extra seal on the dip-pipes means a big loss of gas per ton of coal. I firmly believe that the hydraulic main is more neglected than any other piece of apparatus in use about a gas-works.

The following point—it perhaps hardly comes within the scope of this short paper, but still bears somewhat upon it—is worth discussion: "Does the gas from a through retort travel up one or both ascension pipes?" I have watched this very closely during the last few months, and found that for days together both ascension pipes would be working alike as long as the temperature in the retort-house on both sides kept somewhere within the range of 8° Fahr. of each other; but when there got to be a greater difference of temperature, owing to the wind changing and blowing in, then the cool side stopped working, and as soon as the temperature became nearly equal again, then both pipes would work. I have known the flushing of the main change the flow of gas from one side to the other—that is, when the cool liquor was run in, the gas travelled to the opposite side; if the seals are kept equal both pipes generally work alike.

Discussion.

The PRESIDENT said they had had a paper containing a great many points on which they might have a lively discussion. He thought if Mr. Chisholm, by an expenditure of £3 odd, could obtain an extra 1000 cubic feet of gas per ton of coal, it was worth a great deal of consideration. Mr. Chisholm had also brought in, at the end of his paper, the question of whether single or through retorts were an advantage or otherwise.

Mr. H. TOBEY (Malton) congratulated Mr. Chisholm upon the excellent paper he had laid before the members, and upon the results he had achieved by means of the alterations he had made upon the hydraulic main. He thought there could be no question that a seal of 3½ or 4 inches was too great. Mr. Chisholm mentioned that, in his opinion, the question of anti-dips had not received much attention in the past. He (Mr. Tobey) could go back about twenty-five years; and he thought that at that time they were afflicted with all sorts of suggestions as to obviating the dip-seal in the hydraulic main. What were called anti-dip arrangements were suggested, some of which had continued, although many had come to nothing. He had adopted one of them himself, but eventually took it out, as it did not seem to work very well. Farther on in the paper, Mr. Chisholm mentioned what might be taken as a safe seal. He thought he stated that with a back-pressure of 24 inches there was danger of the engine stopping, and he seemed to consider that his seal would stand this pressure. He (Mr. Tobey) did not quite agree with him on this point. If he had a length of hydraulic main to each setting, and worked the matter out, he would find that, supposing the area in the main for every particular setting was 15 square feet, on the surface of the liquor in the main, and if they took it that the area of the dip-pipes was about 15¾ feet, when he came to about 12 inches pressure with liquor in the hydraulic main, the gas would begin to pass out by the dip-pipes, and get down into the retort-settings. He had experienced this himself. The engine stopped, and it blew the seal. The pressure inside the main was, he thought, about 12 inches; but it was sufficient to unseal the dip-pipes. They knew that crude gas had a very low temperature at which it would light, but this setting was put out; so that he did not think that, with a pressure of 24 inches, Mr. Chisholm could go on with safety, without having great fear of something serious happening to his settings.

Mr. C. DRU DRURY (Sunderland), while heartily congratulating the author, hardly agreed with him that the attention which the hydraulic main had received was but small. What he found was that the hydraulic main had received a great deal of attention; and certainly if he were to make dividends in the retort-house he must pay great attention to the hydraulic main. Probably all of them had fancies as to the shape of the hydraulic main and the regulating seals; but he thought that, as a rule, if they treated them properly, and took off the tar and liquor correctly, it did not matter very much what the shape was. He had, in his works, five different types of hydraulic mains, varying from 18 inches circular and 24 inches U-shaped, up to cast-iron ones, 30 inches wide. He had altered the circular and the U-shaped types to the flat-bottom pattern, by the very simple expedient of filling them with concrete up to within 2 inches of the bottom of the dip-pipes, and providing a suitable arrangement of his own design, for drawing off the tar at once and leaving the liquor sealed, with very satisfactory results. Really there was very little to choose in ordinary working between the two sections of main. He thought that probably most of the forms of hydraulic main followed Sir George Livesey's idea, which was to have a nearly flat bottom, with arrangements for taking the tar off and sealing the dip-pipes in liquor. He thought they were all agreed that they ought to work with as little of a liquor seal as possible. Unfortunately, he was not able to work with so light a seal as he could wish, owing to the fact that in his works he had three retort-houses, with one outlet main, and connected up to one set of exhausters. He was thus obliged to work with a heavier seal than he could otherwise do, owing to the difficulty of regulating the vacuum in each retort-house. He found that very often he had to have a very heavy pull on some of the houses, in order to regulate the seal. His idea was that things would be very much improved by introducing retort-house governors. Then they could work each retort-house on what vacuum they liked, and if necessary work with a dry main. Talking of anti-dip arrangements, he remembered that about twenty years ago, when he was at Vauxhall, he had a whole bench fitted up with anti-dip pipes; and they had a terrible time of it with them, with the result that, in a very short period, they all had to be scrapped.

Mr. A. C. HOVEY (Tynemouth) commented upon the success of the design which was explained in the paper, and recalled that he had read a paper before the Association in 1903, in which he mentioned that at North Shields they had done away with anti-dip pipes, owing to the design of the hydraulic mains and the method of taking the tar off; and that it had been a permanent success. Perhaps he might mention that, in taking the tar off, they had no pipe less than 4 inches in diameter. There was a casting on the back of the main—the back of the main being vertical—and the hole in the main was 4 inches square. Near the top of this casting was a 4-inch liquor seal-valve, and near the bottom was a 2-inch tar-cock, which was generally kept closed. In ordinary working, the tar and the liquor would flow over the seal-valve; but, after every charge was put in, it was the duty of one man to switch the tar-cock on and off again. In doing so, they got away any obstruction which might occur from time to time inside the outlet. There was one special detail with reference to the turning on and off of the cock, which was very beneficial. This was, that when the cock was shut off, it was shut off very rapidly, and, owing to there being a considerable flow of tar at the moment, the large flow of tar and liquor, which was then in motion, being suddenly brought to a standstill, a hydraulic ram action arose, which resulted in causing the liquor to flow, for a short time, rapidly over the 4-inch liquor-valve—thus clearing away all obstructions. As soon as this action ceased, the normal working continued. He noticed on the diagram that there was a 1¼-inch pipe inside the 3-inch one. Then there was a coupling on the outside of the smaller pipe, the outside diameter of which would be 2 inches; so that there was an annular space the tar had to travel in of only about ½ inch in width. Now, if Mr. Chisholm could maintain his tar of a sufficiently liquid character to flow over this, all would be well; but if any thick tar went into the main, then he should imagine it would very soon be stopped up. He quite agreed as to the amount of the seal of the pipes. The idea, of course, was to work as nearly as possible to a level gauge; but where analysts might enter the works at any moment, it was necessary to keep a little more seal on than they would like to. As to the travel of gas up the ascension pipes, he recently had all the pipes in the retort-house tried, and found that about 15 per cent. of them were not working. This was because of the outside temperature. When a pipe was found to be cold, it did not necessarily follow that it was not working; it might be so owing to the condition of the charge.

Mr. J. HOLLIDAY (Hull) said, as to the hydraulic main receiving the attention it should do, and always receiving that attention, he was afraid he must agree with the speakers who took the opposite view. They had a case in point here, in a gas-works making practically a million feet a day; and the seal-pipe, three years ago, was in the position in which Mr. Chisholm said it was. This was a concrete instance in which the hydraulic main did not receive due attention. He was engaged upon several works a short time ago; and he found there that the hydraulic mains were not receiving the attention they ought. In some cases the seal was as much as 9 inches, coming down to 7 and 6 inches; and the least was 4½ inches only. In regard to the paper generally, he thought that Mr. Chisholm simply gave the device as a cheap and efficient way out of a difficulty. Personally he was exceedingly indebted to Mr. Chisholm for having brought it forward in the way he had done. It had saved the Company a very considerable amount of money, without making very much radical change. In regard to its working, he could also speak. There had been no difficulty since it had been put in—no difficulty in the tar catching the sides of the outlet, and blocking it, so far as he knew. At any one period it had been perfectly free in its working. The results obtained from it spoke for themselves. The profits, as they all knew, were undoubtedly made in the retort-house; and, in this instance, the device helped them considerably to retrieve a very awkward position.

Mr. H. LEES (Hexham) said that during the past few months he had had to study the subject to some extent—more academically than from a practical standpoint—and he was old enough, as Mr. Tobey was, to remember the time when anti-dips were fashionable, or at least when a good many people experimented with them. If his memory served him right, without having looked up the history of the period, the main object of anti-dips then was to overcome the difficulty from stopped pipes. The present crusade, if he might so call it, which had been resuscitated within the last few years, had the further object in view of as far as possible considerably increasing the make of gas per ton of coal carbonized. It was quite true, as had been said, that much attention had been given to the matter of the hydraulic main; but it was equally true, as the writer of the paper stated—and he thought they would agree with him—that in many works it had been overlooked. As the last speaker had pointed out, this was

an instance, and they all knew of cases, in which the hydraulic main had not really received the attention which it ought to have done. And if results up to 12,000 cubic feet of gas per ton of coal carbonized were obtained by a slight manipulation of the hydraulic seal, then he (Mr. Lees) thought that many of them had something yet to learn. Not many of them could produce such results under ordinary conditions of working. Many of the arrangements that were before the gas public at the present time were not new in principle. Neither were they very largely new in regard to the application of the principles which were involved. In his reading, a little time ago, he looked up the back numbers of the "JOURNAL OF GAS LIGHTING"—he thought about the year 1877—and in two or three numbers about that period were to be found articles upon the subject of hydraulic mains and tar take-offs. There was a wonderful similarity, in regard to all these arrangements, to what were being put on the market as patents. They had the three-way cock, the displacing charger, and the displacing piston, and many other things of this kind which were now being used, and used successfully, perhaps in a more perfect form than when first introduced. But there was the fact that arrangements which were now being studied and given effect to, were not altogether new. They were new, perhaps, in this sense that, while some might have conceived the ideas at the present time, others had had the same ones before. And there was a probability that some of these ideas at the present time might be of very practical use and some might be of permanent use. If such results as were claimed in this matter were to be obtained permanently, he thought they would all agree that they could not pay too much attention to the subject of hydraulic mains. He was personally very much indebted to Mr. Chisholm for having brought the matter forward; and he thought they would all benefit considerably by it.

Mr. A. F. YOUNG (Cockermouth) said it seemed to him that the pressure of the liquor was the chief part in the arrangement; and what he would like to know was whether the cold liquor coming into the hydraulic main cooled the tar, converting it to pitch. He remembered that they tried something of this sort, and the tar pitched, and they had to clean out the apparatus pretty often.

Mr. M. LEAF (York) said he had been very much interested in listening to the discussion. The subject was one that he had very often forced upon him many years ago. In the first place, it was owing to the difference of temperature at the two sides of the retort-bench, as mentioned in the paper. They had a new retort-house; and it was a very spacious one—at least, according to the ideas of that day. They were very much troubled with the gas all passing up one ascension-pipe. They were through retorts, of 20 feet. During one charge the gas would all pass up one ascension-pipe, and then, owing to the varying heats of the retorts, they would find it, at another time, going up the other side. They were working with tar-seals; and they found that they could not very well get over the difficulty. He set to work to see what could be done; and he arranged a very simple take-off for the tar, which they had in use at present. One of the points connected with it was that they flushed the main, so to speak, every charge. That was to say, during the charge they slowed the engine. The liquor in the main was, of course, level with the bridge-valve; and when they slowed the engine, and put on, say, an inch extra pressure, the weight of the liquor forced the tar out quickly, and they found that practically all the tar, which would otherwise be sluggish in the main, was forced through the take-off. When they worked freely with the liquor-seals, they went on without any trouble. They stopped making gas on Sundays from six in the morning till six at night; and then they had to be careful to shut off the tar take-off. As a rule, it worked automatically all the week through; and they always had the liquor-seal so as to have the pressure *nil* during the working.

Mr. F. P. TARRATT (Darlington) said he was rather surprised at the tar take-off pipe, because he often found that it was with difficulty he could get tar through. How it was possible, working with high heats, to get the tar away from the bottom of the main, through so small a pipe, was rather beyond his comprehension. At any rate, it was not in agreement with his experience.

The PRESIDENT remarked that in his own works the only difficulty he found with the hydraulic main was when he was working with both inclined and horizontal retorts, on account of the great difference in the hydraulic main areas; but he always tried to work along with the seal on the inclines, and let the horizontals look after themselves, because they were only worked in winter. Therefore, so far as this was concerned, he had very little experience in the matter.

Mr. CHISHOLM said that the pipe referred to by Mr. Tarratt was a 4-inch one. It was the pipe they used to flush the small pipe. It had been in use for months, and there were no signs of any sticking. With a continuous stream, it kept the tar always on the run; and they had not had a stopped pipe in this section since last July. The make of gas per ton of coal in January and February of this year was 11,686 cubic feet; while for the corresponding months the previous year it was 10,065 cubic feet. As to the engine stopping, he had been at Hull for three years, and the engine had never been stopped yet; so he had nothing to fear on that score. There was no stiff tar. The tar did, at an odd time, get up; but as soon as it was flushed it went away. With regard to the dip-pipes, they were $4\frac{3}{4}$ inches diameter; so that there was not much chance of anything being left inside them. In reference to the illuminating power of the gas, the City Analyst, as well as the City Gas Examiner, came into the works, and the tests ran from 15 to $15\frac{1}{2}$ candles; so that they had not found any depreciation since they had the larger make per ton.

COAL GAS AND ITS RIVALS FOR MOTIVE POWER.

An interesting lecture on the above subject had been prepared by Mr. Dugald Clerk, M.Inst.C.E., F.C.S., of London.

The PRESIDENT said the lecture would be delivered by Mr. M. Atkinson Adam, B.Sc. He might say that when he was in communication with Mr. Clerk, he inadvertently made a mistake between the first Saturday and the last Saturday of April; and he obtained the promise of a lecture for the first Saturday, which otherwise they would not have got. Mr. Clerk could not be present that day; but he had allowed his partner to come and deliver the lecture. They were very sorry that Mr. Clerk could not come himself; but they very gladly accepted the services of Mr. Adam.

Mr. ADAM then gave the lecture, which will be found on p. 297, and afterwards went over in detail and explained an excellent series of diagrams exhibited on the walls.

At the close of the lecture,

The PRESIDENT said that Mr. H. N. Bickerton, the Managing-Director of the National Gas-Engine Company, had intended to be present, but had been unable to get there. He had, however, sent him a few notes, and had asked him to read them. In the course of his notes, Mr. Bickerton submitted for the consideration of the meeting the question of the advisability of gas companies and gas committees following the example of the electricity companies in supplying gas-engines on similar terms to those under which motors are generally supplied for the generation of electricity. He thought if this policy were adopted, it would be easy not only to compete with electricity for power purposes, but also for lighting, by supplying a small local gas-driven electric generation set of gas-engine and dynamo for use in theatres, hotels, warehouses, or shops. He submitted a hypothetical case in which a retail shop fitted with 300 incandescent lamps of 16-candle power, or the equivalent in arcs, was shown to cost, at the low-scale charge of 3d. per unit, £300; while an installation of a gas-engine and dynamo, at a like outlay, would not only ensure a customer for gas of £60 per annum, with a return of 10 per cent. interest and ample depreciation, but at the same time save the user more than 50 per cent. of his cost of lighting. He said it seemed to him that while at present the electricity supply companies appeared to be formidable rivals to gas companies, they were really, after all, at the mercy of the enterprising gas engineer, as it was only by charging exorbitant prices for their current that they were able to supply it at a low figure.

Mr. W. HARDIE (Tynemouth) proposed a vote of thanks to Mr. Chisholm, to Mr. Dugald Clerk, and to Mr. Adam. The paper by Mr. Chisholm was an eminently practical one. It was upon a subject which, of course, they were all interested in; and it was just by attention to such details as Mr. Chisholm had mentioned that they could hope to effect economies and to get their prices down to the low figures such as Mr. Clerk was very anxious that they should. He had been much pleased with the lecture. There could be no doubt that it contained an amount of matter which was not easy to grasp just at once; but he believed that, in the main, they agreed entirely with what was in the lecture. As regarded cost, the figures which had been given would be useful for purposes of comparison, in very exhaustive detail, upon a subject on which it was sometimes difficult to get correct details. As regarded the selling price of gas, the way in which electric light and power companies had been reducing their prices lately was, of course, making the competition which they had, which was very considerable. Gas companies, however, were not—he was almost going to say—afraid of it, but were doing the best they could for the purpose of meeting this competition. The price of gas, as they all knew, had been recently coming down throughout the country; and he thought that, if electric light people were going to cut prices for power so very low, gas companies would also do the same. They were doing it in some important towns, and it was likely that it would be done in other quarters. Gas companies could well afford—at least, he thought so—in large towns, to reduce the price for power purposes very considerably. If they were to go in for differential prices, these were sometimes considered a little unfair to users for other purposes; but when they considered the increase of consumption they would get, by selling gas for motor power purposes at a low price, they would probably see that they were doing nothing unfair to consumers of gas for other purposes. He, of course, quite agreed with what Mr. Clerk said about low-grade gas. It was absurd that, at this time of day, people should be seeking to put illuminating power restrictions upon their gas. What they wanted was gas of a good flame temperature, so that they could get good results in other directions.

Mr. DRU DRURY seconded the motion, which was unanimously agreed to.

Mr. CHISHOLM and Mr. ADAM acknowledged the vote; the latter remarking that he had to thank them especially for accepting second-hand delivery. He had done the best he could; but, of course, he could not pretend to be able to wear the cloak of Elijah.

ELECTION OF OFFICERS.

The PRESIDENT intimated that the report of the Scrutineers showed that the following had been elected officers for the year:—

President.—Mr. M. Leaf, of York.
Vice-President.—Mr. T. Hardie, of Elswick.
Auditor.—Mr. C. H. Armstrong, of Wallsend.
Hon. Secretary.—Mr. Herbert Lees, of Hexham.
Members of Committee.—Mr. W. Doig Gibb, of Newcastle; and Mr. H. Wilkinson, of Harrogate.

Votes of thanks to the Scrutineers and the Committee having been accorded,

Mr. LEAF, on behalf of the Committee, returned thanks. He had not been able to attend Committee meetings recently, on account of the state of his health not having been so satisfactory as he should have liked. He took the opportunity of thanking them for placing him in the position of being President for the coming year. It was twenty-three years since his predecessor was President of the Association; and he had the authority of his Chairman and Directors for saying that they would be glad indeed to welcome the members of the Association to York in the autumn, if it were agreeable and convenient for the meeting to be held there. He asked them to accord the President a vote of thanks for his services during the past year, and of their deep sympathy with him in the great loss he recently sustained.

Mr. W. COWLEY (Spennymoor) seconded; and the motion was agreed to.

The PRESIDENT, in a few words, returned thanks, and the proceedings terminated.

The members and friends afterwards dined together in the County Hotel—Mr. Anderson in the chair. The toast of "The North of England Gas Managers' Association" was proposed by Mr. A. P. Main, of Glasgow, and that of "Kindred Associations" by Mr. F. P. Tarratt, of Darlington.

JUNIOR INSTITUTION OF ENGINEERS.

Incorporation to be Applied for.

A largely attended Special Meeting of the Institution was held at the Westminster Palace Hotel on Friday evening, for the purpose of taking the necessary steps to proceed with arrangements for the incorporation of the Institution. Mr. Samuel Cutler, jun., the Chairman of the Institution, presided. In proposing the formal but important resolution (which marks the first stage in further raising the dignity of the organization), he remarked that the present year was an important one in the annals of the Society, and that the Council had considered the present as a fitting opportunity to mark this event by endeavouring to enhance the status of the Institution in one or two ways. He referred to the annual dinner held in February, at which a number of notable and distinguished guests were present, who, in their speeches, gave great encouragement to the work that the Institution are doing. The summer meeting this year in London takes place at the end of June; and the Chairman was able to make the announcement that the opening ceremony will be a reception by the Lord Mayor and Sheriffs at the Guildhall. A series of visits to London's representative industrial engineering establishments forms part of the programme; and there will be a conversazione and the usual meetings for the discussion of subjects of interest to the members. Reference was made to the increasing rate of membership; the number of applications received this year passing all previous records. The Council are hoping to realize their desire, expressed at the commencement of the session, that the membership will reach 1000 before the "majority-year" has passed. Introducing next the subject of incorporation, the Chairman stated that the Articles of Association had been prepared by the Hon. Solicitors (Messrs. Batchelor, Cousins, and Warren), and had already been thoroughly gone into in great detail by the Special Committee appointed by the Council. The following resolution was then put to the meeting, and carried unanimously: "That this Association be registered under the Companies Acts, 1862 to 1900, as a Company limited by guarantee, and not having a capital divided into shares, and that application be made to the Board of Trade for a licence directing the registration of this Association with limited liability without the addition of the word 'limited' to its name." As to future arrangements, it may be mentioned that on Saturday week there will be a visit to Dorking, where the gas, water, and electricity works will be inspected.

The Memorial to the Late Mr. Richmond.—The window which has been placed in St. Helen's Church, Darley Dale, as a tribute to the memory of the late Mr. E. W. T. Richmond, and of which an illustrated description appeared in the "JOURNAL" a fortnight ago, was unveiled on the 20th ult.; the representatives of the firm and a large number of the employees at the works journeying to Darley Dale for the purpose of attending the ceremony. As has been stated, the window is the gift of the Company's officials and men; the subscribers numbering nearly a thousand.

THE STARTING OF THE METHANE-HYDROGEN GAS PLANT AT TRURO.

Inaugural Ceremony.

One of the largest and most representative gatherings in connection with the gas industry that has been seen in Cornwall of recent years took place on Wednesday last at Truro, when the new methane-hydrogen plant described and illustrated in the "JOURNAL" last week (p. 225) was formally inaugurated. Invitations had been issued by the Directors of the Company to the members of the Corporation and other leading representatives of the city, as well as to those interested in gas-making in other towns of the county and elsewhere. Among those who attended were Professor Vivian B. Lewes; Mr. D. Irving, the President of the Institution of Gas Engineers; Mr. G. Airth, the President of the Irish Gas Association; Major Mead, the Chairman, Mr. Buckley, the Manager, and Mr. Carne, a Director of the Falmouth Gas Company; Mr. J. M. Thomas, the Manager of the Penryn Gas Company; Mr. Chirgwin, Chairman, and Mr. Nicholls, Manager of the Penzance Gas-Works; Mr. H. E. Riley, the Manager of the St. Austell Gas-Works; Mr. Howard Lanyon, the Manager of the Redruth Gas Company; and a representative of Messrs. Coward and Co. Mr. John James, the Chairman of the Truro Company, Mr. S. J. Ingram, the Engineer and Manager, and the Directors received the visitors; and there were also present Mr. Wall, Mr. J. W. Russell Wall, and other members of the firm of Messrs. Biggs, Wall, and Co., the makers of the plant, together with Mr. C. B. Tully, the patentee, and Mr. MacGregor, who have been the Resident Engineers during its erection.

Mr. JAMES, in welcoming the company, said they aimed at producing gas as cheaply as possible in the interest both of the shareholders and of the consumers. They believed that, in the plant which had been laid down, they had the very best means of making gas, and that it would lead to improvements which would be of great advantage to the consumers. In Mr. Ingram, the Company had a very painstaking and able officer; and Messrs. Biggs, Wall, and Co. had reason to be very pleased that they had fallen into good hands in this respect.

Mr. INGRAM briefly described the plant and the simplicity of its operation, and said that in recent years the flood-tide of prosperity had been with gas companies, and its more distant waves had been felt at Truro. During the past ten years they had had an increase of about 60 per cent. in the output of gas; and it had been a question of meeting the demand in the most economical way. They had ventured upon an experiment; but his confidence in the methane-hydrogen process had been justified by the results so far obtained, and he believed it gave the fullest satisfaction and answered the expectations of the Contractors. The plant was in duplicate, so that there was no risk of a breakdown.

Mr. IRVING said it was remarkable that the flood-tide of prosperity to which Mr. Ingram had referred coincided with the greatest competition and opposition to which the gas industry had ever been subjected. From what he had seen of the Truro works, he had no hesitation in describing it as one of the best undertakings for its size in the country. He congratulated the town upon possessing a Gas Company and a Manager who had the courage to strike out a new line for themselves, and to adopt a process which was untried upon a commercial scale. He had also to congratulate the Company and the Contractors on the excellence of the workmanship throughout the installation, for everything was of the best quality.

Mr. JAMES then started the plant, and the simplicity of the operation, which is all controlled by one lever, as well as the smooth running of the machinery, was shown in practice.

Professor LEWES remarked that they were present at the beginning of one of the most important developments in modern gas making. It was at the option of the Gas Company to put in either carburetted water-gas apparatus or plant for the manufacture of methane-hydrogen gas. There were two factors which rendered carburetted water-gas plant unfit for works of this size and character. One was that, in order to work it economically, it must be continuously employed; and the second was that it put them absolutely in the hands of the foreign oil producers. There was a curious pulsation always taking place between the demand for oil, the price of oil, and the opening of new carburetted water-gas works. As the number of carburetted water-gas plants increased, the price of oil crept up; and it continued to rise until it could hardly be used for gas making. Then came a period when no one put in carburetted water-gas plant; and the price of oil dropped. This process went on, and was producing conditions which would be found more and more irksome. There were certain towns which had been ill-advised enough to think of having water gas for comparatively small works; and in these the pinch was sure to come. In Truro, they were working on very different principles. They had not a very abundant market for either coke or tar; and by the process they had introduced they lessened the difficulty of disposing of these products in a profitable way. The whole tendency of the present day was to decrease the price of gas, and to make it widely available for heating and power, as well as lighting. These were the practical lines on which they had to work; and he hoped that in Truro the

Gas Company and the Manager would be backed up in the excellent work they were doing. Congratulations were due to Mr. Ingram and the Contractors upon the excellent plant which had been erected.

AN INSPECTION OF THE PLANT AND A LUNCHEON.

The company then made a tour of the new portion of the works, which, in spite of the difficulties of a rather cramped site, is admirably laid out. Afterwards an adjournment was made to the Red Lion Hotel for luncheon, at which Mr. James presided.

Major MEAD, the Chairman of the Falmouth Gas Company, at its close, proposed the toast of "The Gas Industry." He congratulated those who had produced the new plant, as well as those who thought of it and those who had the courage to introduce it. He had no doubt that the consumers—to whom, after all, their first duty was due—would have reason to be satisfied with the result. Some time ago, he was associated with an electric lighting company, which was to supply electricity from central stations at Par and Hayle, and was going to wipe out almost all the gas companies in West Cornwall. Nothing came of the scheme; but he had since wondered whether gas could not be more economically manufactured if there was an amalgamation of gas companies in West Cornwall and a central station from which it could distributed. If electricity made greater strides in the future, they would have to consider how the competition could be met; and if amalgamation was a means to this end, they who had charge of the different undertakings must devise means for united action.

Professor LEWES, in responding to the toast, said that the gas industry was his great hobby, and his work in connection with it almost was a labour of love. That morning they had seen a most interesting installation—valuable in itself as a means of producing gas, and a great safeguard to the gas manager, because in the case of a breakdown of the ordinary plant, it gave him the means of making a large quantity of gas at very short notice. With reference to Major Mead's interesting suggestion, they had to remember that, while electricity was supplied at 6d. or even 4d. per unit, gas could simply laugh at it as a competitor; for gas could be supplied at one-third the cost. In the past few years, there had, however, been installations in some of the great towns of the North from which electricity was being supplied at something like ¾d. per unit. This result had been attained by strict economy in management, by housing machinery in sheds which, although substantial, involved little capital outlay, and by using steam-turbines instead of reciprocating steam-engines. A scheme on similar lines for London was now before Parliament. If they had anything of this kind in Cornwall, electricity would become a serious competitor, and centralization might become necessary, though not so much for lighting as for power. It was possible to make a rich fuel gas of 400 or 500 B.T.U. which would compete with anything that could be produced in the way of cheap electricity. He thought, however, the day was far distant when any scheme of this kind would be necessary in Cornwall; and personally he should be sorry to see centralization adopted, because it would sweep away the incentive to personal endeavour.

Mr. IRVING, who also replied, said he thought the gas industry was never in a more prosperous condition than at present. It was not only holding its ground, but was making steady and gratifying progress. With the incandescent burner properly used and cared for, gas had nothing to fear from the electric light as a competitor. Light for light, it could be produced at one-third the cost, and it had the great advantage of reliability. The advantages claimed for electricity, particularly on hygienic grounds, seemed to him very much over-rated. Electrically lighted rooms were generally ill-ventilated. A far more serious competitor was power gas—both in large installations and in suction plants—which could be adapted for all individual supplies. Against such a competitor, they could only hold their own by wisely and judiciously adopting every means of producing gas cheaply. The Truro Gas Company were to be congratulated on the plant which they had seen that day. It marked a period not only in the history of the Company, but in the history of the gas industry. So far as he could judge, there was every prospect of its being eminently successful. The chief objection to Major Mead's interesting suggestion respecting the supply of gas from central stations was the great cost of distribution. It was possible to meet competition in other ways. In Bristol, electricity was supplied for power purposes at about 1⅝d. per unit; but the Gas Company had been able to hold their own in that field. They had reduced the price of gas to 1s. 9d. per 1000 cubic feet; and he had no doubt the time would come when it would be necessary for the Company to so arrange their works as to supply gas at 1s. 6d. or even 1s. 3d. per 1000 feet. The great point that should be kept in view was the interest of the consumer. He believed in free and open competition, and only so long as the gas industry could serve the consumers did it deserve, or would it continue, to prosper. There was no better criterion of the condition of an industry than the financial aspect of it; and the fact that a recent issue of capital in the Truro Gas Company was applied for twice over was evidence of the confidence which was reposed in the undertaking.

Mr. AIRTH also briefly acknowledged the toast.

Major MEAD said that figures which were put before him some time ago went to show that the cost of distributing either gas or electricity from a central station would be about the same. With regard to the invention of gas, its discoverer was not William Murdoch, the Scotsman, but a man named Hornblower, a drunken fellow, who lived at Ponsanooth, in Cornwall, and was a millwright. He (Major Mead) once knew a man named Rapson who, with Murdoch, served his time with Hornblower. After his drinking bouts Hornblower always came back with an idea; and one day he started the manufacture of gas. He lit a shop not a mile out of Penryn with gas. Murdoch afterwards went to Redruth, and there made gas; but the discovery was not his, but Hornblower's. Major Mead added that the first gas-works in Falmouth were put up at the Royal Hotel in that town, and there still remained certain arches in which carriages were put which were a part of the old works. His father bought the first gas-works in Cornwall, and he had bought the hotel in which the first gas-works in Falmouth were built. Thus it came about that the newest invention in gas manufacture had been erected in a town only a few miles from where gas was invented.

The CHAIRMAN proposed the toast of "The Contractors," and spoke highly of the great ability and careful attention which they had shown in the erection of the plant.

Mr. TULLY, in reply, said that the plant was the result of about five years' work and much anxiety. He first got the idea from a lecture by Professor Lewes, in which methane-hydrogen was referred to as a diluent of acetylene. It occurred to him then that if it was good for acetylene it might be used as a mixture with coal gas; and his experiments led to the results which were seen in the erection of that plant. He was obliged to Mr. Ingram for his very great assistance during the erection of the plant, and he believed that, under Mr. Ingram's charge, it would show increasingly better results.

Mr. MACGREGOR said that the work had not been without difficulty, because of the nature of the site; but the difficulty had been overcome, and the plant had worked most satisfactorily.

Mr. RUSSELL WALL remarked that his firm had spent some thousands of pounds in developing this process, and upon the present plant had lost about £600. They had, however, determined that nothing should be wanting which would contribute to its success; and as the result they had the beautifully smooth working which had been witnessed that day. This plant produced gas cheaper than any other plant in existence; and its operation was as simple as anything that could be designed. The Gas Company were not likely to regret their bargain.

The health of the Chairman having been proposed,

The CHAIRMAN, in reply, warmly eulogized the services of Mr. Ingram, who, he said, devoted his energies to the interests of the city and of the Company. The Directors had very great confidence in him, and they trusted that he would be with them for many years to share in the growing prosperity of the Truro Gas Company.

Mr. J. P. PAULL, a Director of the Company, supported the Chairman's remarks, and said they knew that Mr. Ingram would never have advised the introduction of plant which he did not believe was best suited for their purpose.

Mr. INGRAM, in responding, spoke of the loyal co-operation of the Directors in measures for the benefit of the Company and of the city, and said that the interests of Truro would always be dear to him.

The company afterwards went for a trip by steamer down the River Fal, and, the weather being fairly warm and bright, found it very enjoyable.

In the evening, Professor Lewes delivered in the Concert Hall, Truro, a lecture on the manufacture and use of gas, extracts from which appear in another part of to-day's issue. There was a capital audience; and the lecture, which was illustrated by lantern-slides shown by Mr. Russell Wall, and apparatus, was greatly enjoyed.

Mr. IRVING, who presided, said that gas lighting had its origin and birth and practical application in the county of Cornwall, and it seemed to be peculiarly fitting that they should have been inaugurating in Truro that day a new system and process of gas making. He congratulated the Directors of the Company and the consumers of gas on its inauguration, venturing to hope that it would result in very great success, and extend and be appreciated far beyond the geographical bounds of the county.

At the conclusion of the lecture,

Mr. JAMES moved that a very hearty vote of thanks be accorded to Professor Lewes.

Mr. ROSE, a member of the Town Council, in supporting the resolution, spoke of the improvement in the lighting of the hall by the introduction of incandescent burners. It was an object-lesson on the value of this method of lighting, and had made the hall much more bright than formerly. The Gas Company were to be congratulated on their forward policy, and upon their excellent and courteous Manager.

The resolution was carried with applause.

The Jäger Purification System—Satisfactory Tests at Oldham.

A year ago the purifying capacity of a purifier of stated dimensions was determinable upon recognized standard lines; but the introduction of the Jäger system appears to have made it necessary to take new factors into account, which allow the dimensions of purifiers to be considerably decreased. In a purifier of the ordinary type, where the oxide or lime is supported upon a series of horizontal grids, the area of the purifier represents the sum total of the contact-surface available; and the thickness of the material is limited by considerations of back-pressure. The patentees of the Jäger system claim to have removed both these limitations, and by so doing to be able to increase the effective capacity of any ordinary purifier from 50 to 100 per cent. We understand that the system has now been adopted for some 50 purifiers at English works; and it should, therefore, be quite possible to arrive at correct conclusions in regard to the advantages claimed for the system, independently of the testimony of the large number of Continental engineers who have adopted it. Mr. J. H. Belton, of Chester, who, as is well known, was one of the pioneers in adopting the system, is, we note, to read a paper on the subject at the forthcoming Leeds meeting of the Manchester District Institution of Gas Engineers; and this will be awaited with interest by a good many managers who are contemplating purifier extensions. We learn that the Oldham Corporation last week instructed Messrs. Cutler and Sons to convert three more boxes at Hollinwood to the Jäger system, as a result of the satisfactory test of one box previously converted; and the system is also being adopted for four new boxes, 30 feet square, at the works now being erected by the Bournemouth Gas Company at Poole. The system is also being installed, among other gas-works, at Harrogate, Burnley, Westgate-on-Sea, Enfield, &c.

PROGRESS IN GAS MANUFACTURE IN ENGLAND AND AMERICA.

Our readers are aware that a feature of recent meetings of the Ohio Gaslight Association has been the presentation of a report by the "Progress Department," which is under the editorship of Mr. Irvin Butterworth. The third of the series was submitted to the members on the occasion of their meeting at Pittsburg a few weeks ago, and we extract from it the chief matters of interest.

In the general remarks with which Mr. Butterworth opens his report, he notes that, considering the fact that the gas business is now one of the most venerable of our manufacturing industries —the production and distribution of gas having been carried on as a business for more than a hundred years—it is rather surprising to find it still so vigorous, and so alert and active in self-improvement along technical lines. While many progressive engineers realize that there is still much room for improvement in the art and *technique* of gas manufacture and distribution, the industry is not behind others in the march of progress, but has quickly adapted itself to changed conditions as they have arisen and made marked technical advancements each year.

The author was unable to obtain a classified list of the American patents issued during the past year pertaining to the gas business; but in England the gas patents deemed worthy of special notice numbered 298, against 310 in 1903, 240 in 1902, and 259 in 1901. This indicates that gas invention fully held its own during the year. In this connection, Mr. Butterworth is obliged to admit, as the result of his work in gathering data for his reports, that Europe, and possibly England alone, produces a greater number of valuable inventions and improvements pertaining to the gas industry than does the United States. He goes on to point out that, on account of the great use of incandescent burners, the present tendency all the world over is in the direction of gas of lower illuminating power. In German cities, the open-flame burner has practically disappeared, and the gas in some places is as low as 10, and even 8 candle power. He quoted the remarks of Professor Lewes, when giving evidence before the Departmental Committee on Gas Testing, to the effect that the supply of gas of high-candle power is now a waste of money, and that London should be supplied with 12-candle gas instead of as, at present, 14-candle.

Mr. Butterworth points to the International Gas Exhibition held at Earl's Court in December as probably the most notable feature of the gas industry during the year. He says it was "a decided and brilliant success, and has undoubtedly been a great stimulus to both the technical and the commercial advancement of the industry in Great Britain, and in fact throughout the world." A significant and interesting action of the French Gas Association was the offering by them of a series of cash prizes, open to the world, for improvements in apparatus for making or using gas, for a new incandescent burner for ordinary use, for improvements in automatic gas lighting, for gas heating and cooking appliances, for appliances using coke, for artistic gas-fittings, and for the best papers on subjects of interest to the gas industry. The author regards as a hopeful sign of the times, for the technical future of the gas industry, the beginning that has been made in co-operative association work between English and American gas engineers. The recognition of the gas industry by the authorities of the Louisiana Purchase Exposition, and the movement towards the federation of Gas Associations in the United States, are also, in his opinion, indicative of the progress of the industry.

Mr. Butterworth then proceeds to notice, more or less in detail, some of the special improvements made during the year in gas apparatus, appliances, and processes; dealing first with the manufacturing department.

Charging and Discharging Machinery.

During the past year, as in the preceding one, there was great activity in perfecting existing types of charging and discharging machinery and in the invention of new types. Mr. Butterworth says that enough progress has been made in this direction to indicate the probability that charging and drawing by hand will soon be a thing of the past, except in very small works. Several works in America now employ charging or discharging machinery, or both. In New York and Indianapolis, the De Brouwer projector is used; the De Brouwer ram being also in use in Indianapolis. In November last year, the De Brouwer machines were in use in 21 plants in England. A ram is now generally employed for pushing coke out of through retorts; and several makes of machines now introduce the coal and push out the coke at one stroke—the front end of the coal trough or scoop constituting the pushing ram. This sort of machine is now in successful use in Lowell (Mass.), and performs the dual operation for one retort in a very few seconds.

Coal and Coke Conveyors.

There has been considerable progress along the line of conveying machinery, and many of the larger gas-works in this country now have equipment of this character. One concern is making a specially designed coke-conveyor, consisting of a steel trough with cast-iron removable bottom plates, and side guides and chains having wearing blocks of cast steel, the combination of iron and steel reducing friction and wear to a minimum. Belt conveyors for bringing coal from the storage bins to the retort-house are also in use in America, as well as pivoted bucket conveyors. Bucket conveyors of various types are becoming more popular. The man-trolley and grab-bucket systems for unloading coal from cars and boats were improved during the year. Hot-coke conveyors are coming into further use, and are being rapidly developed in various forms, such as grids, gravity buckets, &c. At Ilford (England), experiments are being made in moving hot coke from the retort-house by blowing it out through a pipe by means of steam; and a patent has been obtained covering this system.* A similar experiment was conducted at Denver about two years ago. A novel form of conveyor has been brought out in England, consisting of a moveable trough supported on inclined spring legs, the trough being jerked backwards and forwards by a small counter-shaft and crank.

Benches and Retorts.

What might be called the double retort-house has been designed in America, contemplating two parallel stacks of throughs, with just sufficient clearance space between them for the operation of a combined charging and discharging machine; the result being a retort-house of greater generating capacity per square foot of ground space than any other form of construction affords. Outside producers have been installed at the New Provan Gas-Works, Glasgow. Efforts are being made to improve the quality of fire-clay goods entering into bench construction. Undoubtedly the greatest interest in carbonizing plant is just now centred in vertical retorts, which were mentioned and described in the report for 1903; and great activity has since been displayed in their development by engineers and inventors. Two or three experimental working plants on this system are now being operated in England and Germany; and while gas engineers who are familiar with its working are not yet entirely satisfied with the results so far obtained, they still believe that it will have a great future. Negotiations are in progress for the erection of benches on this system in France, Germany, Russia, Holland, and the United States. It is claimed for the vertical system that both the quality and the yield of gas are increased, and that most excellent coke is produced. Slack coal can be advantageously used, and the distillation is continuous; thereby realizing the long-cherished ideal of gas engineers. It has recently been discovered also that under certain conditions, which probably can be maintained, no naphthalene is produced by this system. The outlook for inclined retorts, in view of the increasing promise of the vertical system and of the remarkably rapid development and introduction of machinery for charging and discharging horizontal retorts, is indeed discouraging; and these competitive methods have sprung into prominence just as the inclined system was apparently about to be carried forward on a tidal wave of popular favour.

Other Forms of Retorts.

The small through retorts, 20 feet long and 13 inches in diameter, set in two vertical rows of five each on each side of the combustion chamber, installed about a year ago at East Greenwich, have been given a furtner trial, but have not proved advantageous. In the Munich Gas-Works, large retorts or "cells," three in a bench, and capable of holding 4400 lbs. of coal each, are being installed; it being the intention to employ 24-hour charges. In these benches the primary air will be pre-heated. At Essen, Herr Blass has recently been experimenting in the distillation of coal by means of highly-heated gas, using a form of vertical and jacketed retort for this purpose; the results of his experiments being quite interesting. A patent covering this method of carbonization was issued to Mr. F. Egner in America in 1889. The interesting method of auto-carburation proposed a year or two ago by Professor Lewes, in which water gas is passed through coal-gas retorts during carbonization, has been given another year's trial, particularly at the Mariendorf works in Berlin, but so far without proving that the system is of much value.

Retort-House Machinery and Apparatus.

A fire-brick concern in America has perfected an automatic arrangement for operating a moveable platform serving as a solid floor covering the pits in front of semi-regenerative benches. An American gas company has designed and put into use a power machine, provided with a hopper, for charging coal into bench furnaces; also a new scurfing device, which gives superior results. Some improvements are claimed to have been made during the year, both in America and in England, in tar-burners, for burning tar under benches or otherwise. One of these burners, of English make, is equipped with an air-inducing ejector for atomizing the tar. The Féry pyrometer has recently been brought out for measuring high temperatures by radiation. Other improvements in pyrometers were made during the year; and recording pyrometers and recording econometers are in use in gas-works in Germany. A new arrangement for dip-pipe seal-regulation is being used in England; an English firm has brought out a new automatic steel-yard coal-weigher; and another has recently brought out a very superior mouthpiece door.

* See "Journal," Vol. LXXXVII., p. 37.

Water-Gas Plants.

Mr. Butterworth cannot find that there was much improvement in water-gas apparatus and processes during the year, although promising experiments are now in progress in certain directions. A methane-hydrogen plant has been erected by an English firm at the Truro Gas-Works, having a modified generator, using either oil or tar, and producing a gas said to contain much less carbon monoxide than ordinary carburetted water gas.* So-called auto-carburation is being adopted in one or two water-gas plants in Germany, employing benzol for this purpose. An instrument called the "water-gas cycle recorder" has been put upon the market in England. It is used as a check upon the workings of water-gas plants.

Washers, Scrubbers, and Condensers.

A very novel tar-extractor was brought out in England during the past year, and progress has been made in the development of the general theory of tar extraction, particularly as regards the removal of so-called tar-fog. There have been minor improvements on both sides of the water in scrubbing and condensing apparatus and systems, but nothing radical or important. The Louisville (Ky.) Gas Company have installed a new construction of vertical multi-tubular condenser, which removes the water of condensation at short periods; and a Scottish firm has produced an annular brush scrubber. One English concern has brought out a liquor turbine distributor for tower scrubbers; while another has produced a new and interesting apparatus designated as "a vaporizing condenser." At least one firm in America is prepared to build cyanogen and naphthalene extractors. The subject and practice of washing gas with absorbent oils, particularly tar oil distillates of various kinds, for the removal of naphthalene from the gas, has had a great revival, particularly in England. During the past year, the gas scholarship students in the University of Michigan gave the subject of the formation of naphthalene a great deal of study, and have added to the stock of knowledge on the subject.

Purification.

Progress in purification matters has been considerable, and chiefly in the direction of the purification of gas by the use of revivified ammoniacal liquor in closed vessels.† Many experiments are being conducted along this line, with most encouraging results. In fact, the system is really now established, and marks a decided advance in purification practice, although this method was exploited several years ago. In dry purification, the introduction of the Jäger grid system has brought about a great improvement in results; the duty of purifying material by its use being nearly doubled under average conditions. A system of purification is in use in Berlin, in conjunction with apparatus for the extraction of cyanogen, which in one works has rendered unnecessary any change of purifiers during the past two years. A gas engineer in America has just patented a process for removing from gas sulphur compounds other than sulphuretted hydrogen. However, in this connection it is interesting to note that the question of sulphur compounds in gas-lighted rooms has recently been thoroughly and scientifically investigated in Europe, with the finding that, under ordinary conditions, there is no increase in the sulphur content of the air in gas-lighted rooms over that of the outside air, but that, on the contrary, there is a decrease, due to the rapid purification by the walls and ceilings. This discovery has attracted considerable attention and comment. A method for mechanically revivifying oxide has been introduced in Europe, in which the foul oxide is carried by power-driven chains through a vertical tower containing a fan, which blows air through the oxide as it passes.

Station Meters.

The rotary meter mentioned in last year's report is making considerable headway; being now used in 150 towns in Great Britain. It is capable of measuring large quantities of gas, costs about half the price of an ordinary station meter, occupies a very small space, and is not liable to suffer much wear or depreciation It is accurate in its operation, and is equally well adapted to either high-pressure or low-pressure gas. The principle of its construction is a fan-wheel, with vanes set at an angle of about 45 degrees. The usual form of station meters has been improved by the construction of a drum that will stand higher rates of speed than heretofore, and the further perfecting of tell-tale indexes. Proportional meters have also been improved by the use of aluminium for such parts as are exposed to corrosion, and by the removal of working parts, so far as possible, from the flow of a large volume of gas.

Gasholders.

A gas engineer in England has brought out a device for blowing the air out of the crowns of gasholders when they are being filled with gas after having been empty. An advance in the construction of large holders is marked in the building, now in progress, of a 15 million cubic feet holder for the Consolidated Gas and Electric Company of New York City, which, when completed, will be the largest gasholder in the world.

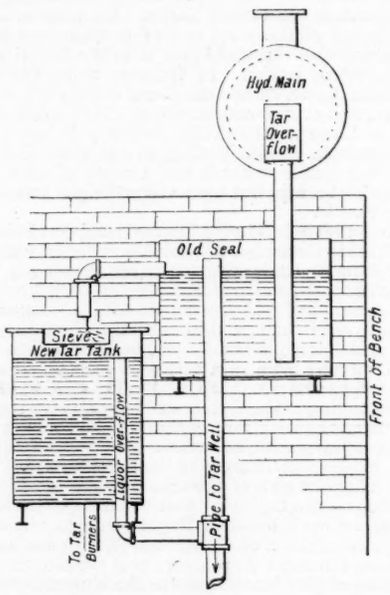
(*To be continued.*)

* See *ante*, p. 225.
† See "Journal," Vol. LXXXVIII., pp. 262, 323.

BURNING TAR UNDER RETORT-BENCHES.

The current number of the "American Gaslight Journal" contains an article by Mr. F. C. Slade on the above subject, which has recently attracted considerable attention, especially in New England. He shows that burning tar is an extremely simple operation; and as he has proved this, under various conditions, during the past few months, he records his experience for the benefit of gas managers generally. Some of these, he acknowledges, already burn their tar with fair success; others consider it is too valuable to burn; while others find it a nuisance. He points out that, for fuel purposes, tar has a value far above that represented by the heat equation. By means of a diagram, he shows the fuel value of tar as compared with coal at different prices. At 1 c. per gallon, it is equivalent to boiler coal at $1·25 per ton; at 2 c., to coal at $2·50; at 4 c., to coal at $5. Water-gas tar has a somewhat higher value than coal tar; but these figures are generally well known. Mr. Slade has been installing a very simple system under benches and boilers with the entire elimination of smoke, with constantly uniform service and continuous operation, and without interruption due to choked burners or other causes; and he says his work has met with considerable satisfaction.

Mr. Slade considers that burning coal tar under benches nearly doubles its fuel value, because of the greatly increased thermal efficiency of the furnace using tar as fuel. Where a bench is not pushed to its full capacity, a gallon of tar is worth nearly a bushel of coke, and the heats can be regulated to a nicety without using any coke whatever. Moreover, the tar need not be pumped. The accompanying illustration shows how this has been done.



In many small works, where one bench will not make quite all the gas, a few charges a day have to be put in another bench. The author has found that by having just enough coke in the furnace to keep the bench warm the tar will burn off these odd charges with the greatest success, with no extra labour and very little coke. The coke fire can be banked between the charges and the tar-burner started about 15 minutes before the retorts are filled. The variation in the heat of the bench is not enough to cause harm.

In plants with electric stations attached having large boilers, Mr. Slade says tar is found peculiarly valuable in carrying over the peak-load in conjunction with the coal fire. In works where enough coal-gas or water-gas tar is made to run a boiler independently of a fuel bed, the grate-bars are removed entirely, and the steam-making problem is reduced to a science, as there is no work attached to firing, and no deposits are left in the tubes. In works where the coal is so cheap that the water-gas tar is allowed to run to waste, these last-mentioned features cannot be overlooked. The tar occupies small space; while however cheap the coal may be, it must be stored and handled. Then the wear and tear on a coal-fired boiler is much greater than on one fired with tar; so that if the coal cost nothing, and there were no market for the tar, it would be a good investment to provide means of saving and burning the tar in preference to using coal. Where soft coal is used for boiler fuel, it has been found that, with a jet of tar over the fire, the smoke from the coal is got rid of. The price received for coal tar is seldom the net profit, since the pumping, barrelling, carting, and shipping expenses have to be allowed; and when it is taken into consideration that all these items, as well as the storing of the tar, are eliminated when it is burned, the actual fuel value is greatly enhanced.

COAL GAS AND ITS RIVALS FOR MOTIVE POWER.

By Dugald Clerk, M.Inst.C.E.

[A Lecture to the North of England Gas Managers' Association, Delivered April 29.]

Three years ago, I had the honour to deliver a lecture at the Southampton meeting of the Gas Institute, upon "Large Gas-Engines and the Gases Used by Them," in which I discussed various points connected with the production and supply of cheap coal gas. Speaking as one interested in the development of the gas-engine, I suggested that a much cheaper gas was very desirable, and would tend to increase the prosperity not only of the gas-engine industry, but of your own industry—the manufacture of coal gas. These suggestions were made entirely from the outside standpoint of a person interested in gas manufacture, but not himself engaged in manufacturing gas; and it may be that, in suggesting the desirability of a public supply of coal gas for power purposes at 1s. per 1000 cubic feet, I was proposing something which was commercially impossible.

The trend of events the last three years seems to me, however to point more strongly than ever in the direction of the necessity for producing such a cheap gas; and as the result of private discussion with several of my friends among the gas manufacturers, I feel that the case is by no means a hopeless one. The coal-gas industry is one to which we gas-engine builders are much indebted for the rapid development and success of our engines. No better fuel could be had for an internal combustion motor than good coal gas; and if coal gas could be supplied cheaply enough, gas-engines of every power would undoubtedly use it.

So long as gas-engines were only capable of being built up to 50-horse power, the great heat efficiency of the engine compensated for the expensive nature of the gaseous fuel. When I say "expensive nature," I only mean, of course, relatively, as compared with the source of heat of the steam-engine—that is, coal burned in the boiler-furnace. Though heat obtained from coal direct was so cheap, yet small steam-engines in towns were very wasteful; and it was not at all unusual in the earlier days to find steam-engines costing as much as 4d. per horse power per hour for fuel and other expenses. Here was the advantage of the gas-engine. Even twenty-five years ago, with gas at about from 2s. 6d. to 3s. per 1000 feet, a gas-engine could give an indicated horse power on 1d. for an hour; and this unit of 1d. per horse-power-hour was the standard of economy for gas-engine use for many years.

This advantage, together with the fact that a small gas-engine required practically speaking no attendance, and, when running light, consumed extremely little gas, enabled the gas-engine of moderate power to practically displace the steam-engine entirely where town's gas could be had. As the engines increased in power, however, they came more and more into competition with steam-engines of a more economical type, partly because large steam-engines are more economical than small, and partly because steam-engine makers naturally devoted themselves to meet their formidable rival, the gas-engine. Accordingly, the ambitious gas-engine constructor, desiring to drive (say) an electric lighting station, now finds himself confronted with many steam-engines capable of developing one horse-power-hour on about one-fifth of a penny for fuel costs. Indeed, in one of the latest examples of a steam-turbine generating station, the surprisingly low figure of one-tenth of a penny is claimed.

With coal gas of about 600 B.T.U. heating value per cubic foot, at 1s. 6d. per 1000 cubic feet, an ordinary modern gas-engine will give one brake-horse-power-hour on about 0·3d. for gas. Obviously, with fuel at this price, the gas-engine could not compete with the large steam-engines above referred to. With gas, however, of the same heat value, at 1s. per 1000 cubic feet, the cost of fuel would be 0·2d.; and at this figure, allowing for the great advantage of the gas-engine using coal gas with its low cost for attendance, &c., the gas-engine could more than hold its own with steam. Gas of 600 B.T.U. value at 1s. per 1000 feet would practically enable the coal-gas manufacturer to cover the whole field of power supply in towns up to at least 150-horse power. Even at 1s. 6d. per 1000 feet, the field would be a very large one, and include all gas-engines—certainly up to 50-horse power. It is, of course, true that no coal gas could be supplied uniformly at this price, unless the public would be content with much lower intrinsic illuminating power than is at present enforced by law.

I have watched, with much interest, the attempts of gas manufacturers to obtain a relaxation of the laws dealing with the illuminating power of gas; and my sympathies are all with those gas manufacturers who advocate cheap gas and low illuminating power. It appears to me that we have looked so long on coal gas as primarily intended for illumination—intended to have intrinsic illuminating power—that we are apt to forget the great changes which have been produced in comparatively few years by the progress of invention.

The invention of the Welsbach mantle has made intrinsic illuminating power practically unnecessary. It seems to me that it would not greatly matter if coal gas had no intrinsic illuminating power whatever. What is really wanted now is a gas capable of giving a high flame-temperature, and a large number of heat-units on its combustion. Any inflammable gas with a heating value of between 500 and 600 B.T.U. per cubic foot would have a flame-temperature amply sufficient to produce the best results with the Welsbach mantle. As you all know, it has been very clearly proved that all that is necessary for maximum illuminating power with the Welsbach mantle is a sufficiently high flame-temperature of the combustion mixture surrounding the mantle. The nearer you can get with any coal gas to the true combustible mixture—that is, a mixture containing just enough oxygen to completely burn the carbon and hydrogen—the more illuminating power will be given out by the mantle.

This was fully proved in an elaborate series of experiments made some years ago in my laboratory on the Kern burner for the Welsbach Company, during the action on the Kern patents. It was strikingly evident in more recent experiments on pressure burners and lamps of the Lucas type, made by Mr. Adam in conjunction with me during 1904. In these experiments, air was measured as well as gas; and it was found that the best illuminating power was obtained with London gas mixtures having 1 volume of gas to 5·4 volumes of air, where the maximum combustible mixture was 1 gas and 5·5 air.

In these and many experiments made in my own laboratory with Welsbach mantles, on pressure and other burners, I have found the illuminating power to depend almost wholly on the flame temperature, and, of course, the fit of the mantle to the flame produced by the particular burner; and with London gas I have many times had a candle power of over 30 candles per cubic foot with a pressure burner.

Properly understood, it seems to me to be rapidly coming to this—that intrinsic illuminating power for coal gas is an antiquated superstition, requiring dismissal from our minds, in order to re-arrange the conditions which best suit the incandescent lamp, the gas-stove, and the gas-engine. I have little doubt that, given liberty on the part of gas manufacturers to discard the idea altogether of intrinsic illuminating power for coal gas, they would soon succeed in producing a cheap gas, capable of distribution in towns, at from 1s. to 1s. 6d. per 1000 feet for heat purposes, such as stoves and gas-engines, and a little dearer for lighting. Such a gas would be a very great boon to the country at large; and it would create an enormous demand—far greater than any existing at present, both for heating and power. I feel confident that, in addition to gas-stoves and gas-engines, such a gas would find its way into many industrial operations, such as welding and furnacing of various kinds, at present conducted by coal-fires.

In a recent inquiry into the standards of illuminating power, I was sorry to see opposition by leading gas manufacturers to proposals for a standard of heating power. It was said that the heating power of coal gas was an object of merely scientific curiosity. Speaking as one interested in the manufacture of gas-engines, I must dissent from this view. What the gas-engine requires is a certain number of heat units at the lowest possible price; and, however high may be the illuminating power of the gas, unless the proper value in heat units per cubic foot is there, the engine cannot possibly give its power economically. What the gas-engine user desires is power; and for power he must have a certain number of heat units for a given price.

I am sure you will pardon me for pressing once again upon an assemblage of engineers interested in gas manufacture the need of a plentiful supply of cheap gas, and the desirability of remodelling our views as to the qualities required in gas.

Many converging forces all tend in one direction, and prove (to my mind, at any rate) the absolute necessity for further developments, both in connection with the gas-engine industry and the gas-manufacturing industry. These converging forces apply pressure to gas manufacturers and gas-engine builders in common up to a certain point—that is, the interests of both are parallel within a certain range. The considerations which bear upon the small gas-engine and gas-engines of moderate power—say up to 150-horse—are different, however, from those which bear upon larger engines, above 150-horse. In the struggle for position against the steam-engine, in its various forms, the gas-engine designer has to consider very different economies from high-power modern steam-plants than were obtained even a few years ago. The keen competition between the reciprocating steam-engine and the turbine-engines of that distinguished engineer, the Hon. C. A. Parsons, have caused advances in fuel economies of steam-plants which were undreamt of a few years ago. And this economical generation of power by large unit steam-turbines and reciprocating engines has led to the cheap generation and supply of electricity for motive power on a scale which threatens the supremacy of the coal-gas driven engine very seriously for small and moderate power.

From information placed before me, I believe that at the Carville works of the Newcastle and District Company, current is generated on the works at a works cost of 0·132d. per unit produced, and the coal cost to produce a unit is only 0·11d. That is, the coal cost per horse-power-hour developed at the engine is considerably under 0·1d. Current so produced, obviously, is capable of offering formidable rivalry to the gas-engine; and many electric lighting and power companies throughout the country have paid special attention to electrical motive power.

So far, the competition of the electricity motor has been felt more against comparatively small gas-engines; but at the small engine end of the gas-engine business, the competition of the electric motor is unmistakable.

I have inquired into the number of electric motors now at work in six districts, of which Newcastle, Leeds, Birmingham, Glasgow, Liverpool, and Bristol form the central cities. In these

districts there appear to be at work now, roughly, a total of some 7000 electric motors, varying in power from 20-horse as a maximum to 1-horse as a minimum. In these districts, the price charged for power per unit varies from 0·55d. to 3d. The rate of 0·55d. per unit appears, however, to apply only to the electricity supply in this district to the North-Eastern Railway Company. The most usual charge seems to be about 1½d. per unit, although for large users of power many companies appear prepared to come down to 1d. and less.

To show clearly the trend of electrical power costs in different towns throughout Britain, I have prepared Table I., mainly from data given in the "Electrical Times Table of Costs and Records." This table, however, so far as generating cost is concerned, refers mostly to the year 1903; and since that time substantial reductions have been made by many companies in both cost of fuel and works costs. From these figures, it may, I think, be taken as quite certain that in a few years we shall see—at least, in the large towns of Britain—electrical power freely supplied at 1d. per unit, and sometimes under.

TABLE I.—TOTAL COSTS AND FUEL COSTS PER UNIT OF ELECTRICITY SOLD.

ELECTRIC LIGHT AND POWER COMPANIES.

	Fuel Cost.	Works Cost.	Total Cost.	Selling Price for Power.
Leeds	0·25d.	0·65d.	0·97d.	1½d. to 2d.
Birmingham	0·64	1·23	1·74	⅞ ,, 2½
Glasgow	0·24	0·60	0·88	1½
Liverpool	0·35	0·68	0·91	1½ ,, 2
Nottingham	0·40	0·74	1·09	1½
Bristol	0·59	1·11	1·58	1 ,, 3
Newcastle district (1903).	0·45	0·82	1·10	—
,, ,, (Carville).	0·11	0·132	—	0·55 ,, 1½
Newcastle-on-Tyne	0·23	0·52	0·85	—
Salford	0·22	0·58	0·76	—
St. Helens	0·20	0 56	0·78	—

ELECTRIC TRAMWAYS.

Glasgow	0·15	—	0·41
Huddersfield	0·19	—	0·35
Leeds	0·19	—	0·34
Newcastle-on-Tyne	0·16	—	0·36

If the ambitious schemes set forth in the Power Bill of the Administrative County of London Company, at present before Parliament, be carried through, and if the promoters be able to produce at the rates mentioned in their evidence, much lower prices than these may be looked for. In this Bill, a maximum price of 1½d. per unit is made. But, according to the evidence, the estimates are framed on a basis of an average price of 0·7d. per unit; and I am informed that the Engineers of this Company expect to go to 0·5d. per unit, and even under. This, of course, is still in the future; but judging by the names of the Engineers concerned, and what I know of them, I think it highly probable that their promises are likely to be fulfilled, if not in London, then in some other city.

While on the question of London, I should say that I am informed that at present the Charing Cross and Strand Electricity Company are quoting $\frac{15}{16}$d. per unit for large powers; and the St. Pancras Borough Council are offering and supply electrical power in London at 1d. per unit. In the area of Greater London, I am informed that the electro-motors at present at work amount to something like 36,000-horse power.

Table II. shows the present prices of coal gas for power in the principal districts of Britain. Taking the average prices, and assuming the gas all round to be of a thermal value of 600 B.T.U. per cubic foot, I have worked out the corresponding fuel and total costs per brake-horse-power-hour for two cases—*i.e.*, with an engine-brake efficiency of 25 and 30 per cent. respectively, and making allowance for interest, depreciation, attendance, and other charges in the case of total costs. The second figure given as to brake efficiency more nearly represents the average gas-engine in general use under ordinary conditions.

TABLE II.—PRICE OF COAL GAS FOR POWER.

	Prices per 1000 Cubic Feet.	Average.	Fuel Cost per B.H.P. Hour	Total Cost.	Fuel Cost per B.H.P. Hour.	Total Cost.
			30 p. ct. Brake Efficiency.		25 p. ct. Brake Efficiency.	
	s. d.	s. d.	d.	d.	d.	d.
Leeds	1 6 to 2 3	1 10½	0·32	0·42	0·35	0·48
Birmingham	1 8 ,, 2 6	2 1	0·36	0·46	0·43	0·53
Glasgow	2 0 ,, 3 0	2 6	0·43	0·53	0·52	0·62
Liverpool	1 1 ,, 2 8	1 10½	0·32	0·42	0·38	0·48
Nottingham	1 6 ,, 2 6	2 0	0·34	0·44	0·41	0·51
Bristol	1 9 ,, 2 0	1 10½	0·32	0·42	0·38	0·48
Newcastle	1 6 ,, 3 3	2 4½	0·40	0·50	0·48	0·58
London	2 0 ,, 2 11	2 5½	0·42	0·52	0·50	0·60
Sheffield	1 2 ,, 1 6	1 4	0 23	0·33	0·27	0·37
Widnes	1 0 ,, 1 4	1 2	0·20	0·30	0·24	0·34

In London, the minimum price for coal gas appears to be 2s. per 1000 feet, with 5 per cent. off for power purposes. At 2s. per 1000 feet, an ordinary gas-engine would give a brake-horse-power for rather less than 0·4d. for fuel alone, and for about 0·5d. total. At 1d. per unit, electrical power is equivalent to 0·75d. per electrical horse power delivered to the consumer. Assuming the brake efficiency of the electric motor to be 85 per cent., then the power delivered costs 0·88d. per brake-horse-power.

It is thus true that, even with London gas, a moderately good gas-engine can give its power for rather over half the cost of that for electricity. But in this connection it is desirable to remember that the electro-motor has some of the advantages, with regard to the gas-engine, which the gas-engine had in the early days as compared with steam. In a gas-motor using town's gas, one very strong point is found in the ease of starting, by simply turning on a tap and giving the fly-wheel a turn. This is a great advantage as compared with the steam-engine. In the electric-motor, all that is required is to turn on a switch, and the motor starts without even the turning of the fly-wheel, which is necessary in the gas-engine. Also the electric-motor occupies very little space, and requires on the whole perhaps rather less attention than the gas-engine. Further, the electric motor has a great advantage for many purposes in rendering countershafting unnecessary. The mere turning on of the switch possesses a fascination for some users; and no doubt this point gives some pull to those supplying electricity, which tends to compensate for the higher price of the power generated electrically. Undoubtedly, the electric-motor has a certain field for very small powers, from which it will not be displaced. Of course, there are not many towns yet where electricity is sold, even for power purposes, at so low a figure as 1d. per unit, and wherever current exceeds this rate, the gas-engine position is immensely strengthened. Even at present prices, in most towns, gas motive power is very much cheaper than electrical motive power. I could quote cases which have occurred in connection with the business of the National Gas-Engine Company, where electricity at 2d. per unit has been replaced by them by gas, with the result that the cost for power was reduced to about one-sixth, and this with gas at 1s. 9d. per 1000 cubic feet.

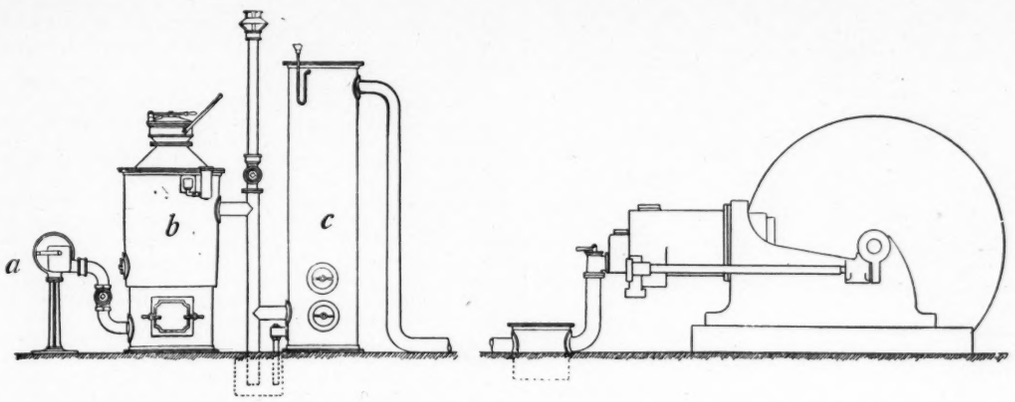
There is no doubt whatever that both electric lighting and electric power companies are pressing very hard to supply motive power; and a certain field will doubtless always be theirs. For powers up to five or six horse, occasionally used, no doubt they will find a considerable field; but if equal pressure were applied by gas companies, in conjunction with gas-engine manufacturers, I am convinced that the electric lighting companies would be prevented from seriously invading the field of larger powers. Even the very small gas-power trade might, it appears to me, to a large extent, be held against the electric companies, if gas companies would combine to let out gas-engines on hire in the same way as they so commonly deal with gas-stoves. The electric companies adopt similar methods; and there seems to be no good reason why the gas companies should not fix gas-engines in the same way as (say) the Tyneside Supply Company, in Newcastle here, fix motors—either on simple hire or else on the five-years hire-purchase system. These companies, I am informed, even go so far as to buy steam or gas engines from the users, in order to instal electro-motors using their current.

A general reduction in the price of gas for motive power throughout the country to 1s. 6d. per 1000 feet, or in some cases to 1s., would aid very materially in meeting this competition. In many cases, indeed, with gas at 1s. per 1000 feet, electricity could be generated by means of gas power at a cheaper rate than many considerable stations now show.

It is interesting to note that the number of gas-engines in use, in the six centres to which I have referred, enormously outnumber electro-motors. These six centres, among them, have something like 25,000 gas-engines in operation; the average power being over 15-horse—in the aggregate approaching 400,000-horse power. Altogether, so far as I can estimate, there appears to be at work in Great Britain and Ireland something like a 1,000,000-horse power in internal combustion motors, mostly driven by coal gas. This enormous power must consume a very appreciable proportion of the coal gas produced in the country. Roughly, so far as my information carries me, the coal gas production of the country appears to be divided equally—25 per cent., illumination without incandescent mantles; 25 per cent., illumination with incandescent mantles; 25 per cent., gas-stoves; and 25 per cent., gas-engines. You will, no doubt, know better than I do as to this division of supply; but some of my gas-manufacturing friends inform me that one-quarter of the whole gas production may be taken roughly as the consumption of the gas-engine.

I have now sufficiently considered the problem, so far as the smaller engines are concerned, and will deal very shortly with the matters which appear to me to be pertinent to the question of the intermediate and large gas-engines.

Gas-engine designers have worked exceedingly hard during the last twenty-five years, and in this time have applied the internal combustion motor to all manner of uses, in power ranging from ½-horse up to 2000-horse and over. They have adapted their motors to the consumption of many different kinds of inflammable gases and vapours; and they have continually increased both mechanical and thermal efficiency, until at the present time they compete with steam in almost every field. For small and moderate powers, their advantages greatly outweigh those of steam; and here we find they have practically displaced steam, and—subject to what I have said as to electric-motors—they have revolutionized the application of power in towns for industries only requiring moderate forces. At first, the gas-motors were practically limited to the use of town's gas; but the expensive nature of the heat unit supplied in the form of coal gas, led Mr. Dowson (who may be called the father of producer gas-engine plant) to introduce his pressure producer, which at once reduced the cost per heat unit supplied to the engine to less than one-half that of coal gas. At a later time, the heavy hydrocarbons were utilized in the form of



(*a*). Hand-power fan for starting gas-generator.
(*b*). Gas generator with air heater, water vapourizer, fuel container, hopper and valve, firegrate, &c., complete.
(*c*). Coke scrubber with water sprayer, water seal, overflow, &c., complete.

DOWSON SUCTION PLANT FOR 40 B.H.P. GAS-ENGINE.

paraffin and petroleum oils; and this widened the field to include agricultural motors and motors required in positions where no town's gas or producer gas was available.

More recently, light gasoline or petrol has been extensively applied, as you know, to internal combustion motors on motor-cars and other motor-vehicles. The petrol-engine, as it is called, has also been applied to the propulsion of light boats. Alcohol, too, has been pressed into the service of these engines; and in Germany and France a considerable number of internal combustion motors are actuated by cheap alcohol distilled from potatoes and other starchy matter. Blast-furnace gas, coke-oven gas, and even (in America) natural gas, are all now used for these engines.

Accordingly, we now witness an interesting competition between different kinds of inflammable gases and vapours for use in internal combustion motors. Each inflammable gas or vapour competitor has its own advantages, and its own field where it reigns supreme. But to a certain extent the fields occupied by each tend to overlap; and, accordingly, we find a struggle for pre-eminence by those interested in the particular gas or vapour. The latest arrival on the scene is gas produced by a method closely analogous to Mr. Dowson's, by the suction producer.

Some four years ago, there was hardly a suction producer in the whole country. The first inspected by me is one operating at the little town of Huesy, near Verviers, supplying gas for two Deutz gas-engines driving an electric lighting station. I visited this installation on Oct. 23, 1901. Since then, the suction form of producer has made great headway, both on the Continent and in this country. As it is doubtless the most interesting form of gas-producer for gas-engines to my audience, I have here a section of the Dowson suction producer, as operating a National gas-engine. I have had occasion to test the Dowson suction producer very carefully, and my partner, Mr. Adam, has visited Mr. Dowson's works at Basingstoke, and carried out a very full test. From this test it may be taken as proved that in the 40-horse power producer, an efficiency of 89 per cent. was obtained; and in the 30-horse power producer, 86 per cent. That is, respectively 89 and 86 per cent. of all the heat of the anthracite used was delivered at the engine in the form of producer gas.

The cost of the fuel used—Western Valley anthracite—delivered at Dowson's works at Basingstoke, was 24s. per ton; and at this cost, 1 brake-horse-hour could be obtained at a fuel charge of $\frac{1}{9}$d. Of course, this $\frac{1}{9}$d. does not represent the whole cost of the gas. It is, however, a figure which can be fairly quoted against the steam-engine cost, because, as compared with the steam-engine, the producer involves much less work, and very little expenditure for either water or repairs. Comparing with the engine driven by coal gas, however, certain additions must be made in order to be strictly fair.

Taking a small suction producer—(say) 30 brake-horse-power size—operating on the basis of fifty weeks per annum, and fifty-two hours per week, assuming an average power of 20 brake-horse-power throughout the whole time, I estimate the total cost, including interest, depreciation, &c., on the producer plant, cost of attendance, cost of fuel, and cost of water, at £60 per annum. Now, assuming a coal gas of 600 B.T.U. calorific value supplied at 1s. 6d. per 1000 feet, I find that the cost of 20 brake-horse-power for the same time runs out at £74 per annum. This, however, does not include any charge for attendance on the engine supplied with coal gas. It may be taken, that although at 1s. 6d. per 1000 feet there is a small advantage in favour of the producer plant for 20-horse power, yet few small producer plants would be introduced into a town where the gas was sold at this price. At anything over 1s. 6d., however, there is a considerable advantage in the suction producer plant.

The great advantage of the suction producer over the older form lies in the very low first cost, the absence of gasholder, the ease of starting, and the long period of time during which the producer can run without any attention whatever.

The cheap gas of the older pressure producer was not obtained without considerable attention to the plant; and consequently the power at which pressure plants began to be applied ranged much higher than those at which suction plants apply. It was rather unusual to apply a pressure plant to any gas-engine below 50-horse power; whereas now engines of 30-horse power and lower are often operated by these plants. Where larger powers are required, the suction plant presents many advantages over the pressure plant; and the increase of power and dimensions is steadily proceeding. Suction plants are now made in this country as high as 300-horse power, and will soon be made to practically any power, in suitable units.

With regard to these plants, they have undoubtedly a certain field, and that field a very large and important one. Above a certain power, they are sure to increase and develop. To what power they come down in ordinary practice, is entirely a matter in the hands of coal-gas manufacturers—that is to say, it depends upon the price at which a good, clean gas can be sold. As I have said, with coal gas at 1s. 6d. per 1000 feet, few suction producers would appear under 50-horse power. With coal gas at 1s. per 1000 feet, my view is that suction producers would be pushed further up the scale, and they would appear about 150 to possibly 200 horse power.

In a field quite away from coal-gas power, the suction producer appears likely to make great headway. I refer to its use for marine engines, and possibly for motor vehicles. A beginning has been made in applying these producers to boats; and it seems to me highly probable that, in the near future, we shall have gas-driven ships with producers even of very large power.

To sum up the comparison of the cost of power from various available fuels, I have prepared Table III. (p. 300). In this table, for ease of comparison, I have taken out the cost of a given number of thermal units in each case, existing in the fuel used as the source of power. I have also given the fuel and total costs per brake-horse-power-hour, allowing for interest and depreciation for comparison with the price for electricity given in Table C. Table A deals with coal gas at the prices I have indicated as desirable. Table B deals with anthracite used in a suction producer plant. Table C deals with coal used in a large electricity supply (power) station generating by means of steam-turbine installations. This represents the best that can be done at present in this country. The first figure given is that for the Carville works of the Newcastle and District Company; while the others show the corresponding costs where fuel is dearer. These figures were the basis of the proposed supply of electricity in bulk in the London district.

It is important to notice the third column of Table C. This is purely hypothetical, and shows what would be the cost of a brake-horse-power-hour if common slack used for steam-raising could be employed in a producer on the same basis as the Dowson suction producer. This is the producer problem of the future. Table D deals with Scotch anthracite, and Table E with heavy oil fuel used in an oil-engine.

I think I have said enough to clearly demonstrate the desirability of combined effort on the part of our gas companies and corporations interested in the manufacture of coal gas, to alter the law of the country in such a way as practically to permit of the abandonment of intrinsic illuminating power as the standard for gas manufacture, and the substitution for that standard of one of calorific power per cubic foot, together with possibly a flame temperature limit, so as to make gas thoroughly suitable for the incandescent lamp, even when it has no intrinsic illuminating power.

I am conscious of the many difficulties of the problem placed before you; but it appears to me to be one which can be solved, if new ideals be adopted by the gas-manufacturing profession. I cannot but think that combined effort would result in convincing Parliament of the public necessity for a great change in the

TABLE III.

A.—*Coal Gas.*

[Calorific value, 600 B.T.U. per cubic foot.]

Cost per 1000 Cubic Feet.	Cost of 10,000 B.T.U.	30 p. ct. Brake Efficiency.		25 p. ct. Brake Efficiency.	
		Fuel Cost per B.H.P. Hour.	Total Cost per B.H.P. Hour.	Fuel Cost per B.H.P. Hour.	Total Cost per B.H.P. Hour.
1s. 0d.	0·2d.	0·17d.	0·27d.	0·20d.	0·30d.
1 6	0·3	0·24	0·34	0·29	0·39

B.—*Anthracite.*

[Calorific value, 14,000 B.T.U. per pound.]

Cost per Ton.	Cost of 10,000 B.T.U.	30 p. ct. Brake Efficiency.*		25 p. ct. Brake Efficiency.*	
		Fuel Cost per B.H.P. Hour.	Total Cost per B.H.P. Hour.	Fuel Cost per B.H.P. Hour.	Total Cost per B.H.P. Hour.
24s.	0·097d.	0·092d.	0·22d.	0·11d.	0·24d.

* Assuming a producer capacity of 85 per cent.

C.—*Coal.*

[Calorific value, 11,500 B.T.U. per pound.]

Cost per Ton.	Cost of 10,000 B.T.U.	Fuel Cost per B.H.P. Hour at 30 p. ct. and 85 p. ct.	Steam Turbine Plant.		
			Fuel Cost per E.H.P.	Sale Price per Unit.	Price per B.H.P. at 85 p. ct. Motor Efficiency.
5s. 9d.	0·029d.	*0·028d.*	0·0825d.	0·55d.	0·49d.
7 6	0·037	*0·035*	0 108	0·72	0·64
8 6	0·044	*0·041*	0·120	0·80	0·72

D.—*Scotch Anthracite.*

[Calorific value, 12,000 B.T.U. per pound.]

Cost per Ton.	Cost of 10,000 B.T.U.	Cost per B.H.P. Hour.
15s.	0·071d.	0·068d.

E.—*Petroleum (Lamp Oil).*

[Calorific value, 20,000 B.T.U. per pound, B.H.P. hour at 0·8 lb.]

Cost per Gallon.	Cost of 10,000 B.T.U.	Cost per B H.P. Hour.	Total Cost per B.H.P. Hour.
6d.	0·33d.	0·53d.	0·63d.
4	0·22	0·35	0·45

conditions of gas manufacture, as regulated by law. Gas managers have not had a chance to show what can be done in the way of producing a cheap, clean gas, of low illuminating power intrinsically, having a high flame-temperature, and a great heating value per cubic foot.

COAL GAS: HOW TO MAKE AND BURN IT.

[Extracts from a Lecture delivered at Truro last Wednesday by Professor Vivian B. Lewes.]

On Wednesday last, at Truro, Professor Vivian B. Lewes delivered an interesting lecture on the above subject, illustrating his remarks by means of limelight views. The lecture was of a popular character; and began with a short account of Murdoch's work and early practice in gas lighting. Professor Lewes prefaced this part of his subject by the remark that, as the crow flies, the distance from Redruth to Truro is but a few miles; but it has taken over a hundred years for the great gas industry to traverse the ground which has been covered since its inception at the former place in 1792 until to-day, when it has reached one of its latest developments in the cathedral city of Truro. The lecturer next proceeded to explain the method of manufacture as carried out in the works of a small country town, the making of carburetted water gas, and the need for enrichment that existed prior to the introduction of incandescent lighting.

Professor Lewes then said: In 1896, the incandescent mantle became an assured success; and it was at once recognized that, inasmuch as a poor quality of coal gas gave quite as good results when burnt with a mantle as the enriched coal gas, it was clear that there was no necessity for keeping up a high illuminating value. From 1896 to the present time, the whole tendency has been to reduce the candle power and cheapen the gas as far as possible, afterwards using it for lighting in incandescent mantle burners. As the incandescent mantle more and more supplants the old form of burner, this tendency will continue until in all probability throughout the whole country the gas supply will average about 12 candles. This change in the idea as to what was required in gas making led to the introduction of other processes by which the volume of the gas obtained from the coal could be supplemented by cheaper methods; and Dellwik having shown how water gas could be made more cheaply than it had ever been produced before, blue water gas is now utilized in many works either for simply mixing with coal gas, or else by passing it through gas-retorts during the carbonization of the coal, or into the foul main—processes which allow of the admixture of 25 to 30 per cent. of water gas with coal gas with a comparatively small reduction in its illuminating value, which, if necessary, can be made up for by the addition of a small quantity of benzol vapour to the finished gas before its distribution to the consumer. In large works, this method has proved itself to be very successful. In small works, however, the volume of gas made is not sufficiently large to keep the water-gas generator constantly working; and the economic benefits to be derived from its use are very greatly minimized by the production of a comparatively small quantity of gas. In consequence of some suggestions made by me, Mr. Tully (who was then the Gas Manager at Sligo) perfected an apparatus which has been introduced into your works, and which I think represents the latest and a most important development in the production of gas.

The profitable working of a gas-works depends largely upon finding a market for the bye-products; and where you have an unlimited output at a good price for the coke and tar, as used to be the case, then the making of simple coal gas becomes a profitable proceeding, owing to the profits obtained on these bye-products. At the present time, however, the production of coke generally exceeds the demand; while tar has indeed fallen upon evil days. The great value of tar used to be dependent upon the fact that the benzol recovered from it was the source from which all the aniline and other bye-products used to be made. But a large proportion of the coke-ovens in England, and still more on the Continent, have been fitted with recovery plant which saves the benzol in the gases given off in the manufacture of metallurgical coke, with the result that its price has so fallen that tar has become practically unsaleable, and many works would be glad to dispose of all they produce at under 1d. a gallon. In several places it is being injected into the furnaces as fuel, as being the only way in which the price obtained for it for paving and other work can in any way be kept up. The idea utilized by Mr. Tully in devising the present plant is to decompose the tar in the red-hot fuel of a small water-gas generator, which breaks it up into soot, methane, and hydrogen. The soot can be filtered off by passing it through a separating column of coke; while the methane and hydrogen, together with the water gas, give the best possible diluent for the coal gas.

The apparatus, which you can see in its latest form in your own gas-works, consists of an iron shell lined with fire-brick, and provided at the bottom with a grate and clinkering doors. The fuel employed in it is coke, fed in through the charging door at the top. So far the apparatus resembles an ordinary water-gas generator. The great difference, however, consists in the fact that at a distance of 4 feet above the grate-bars, the fire-brick lining contains nostrils or outlets, through which, during the process of blowing up, the products of combustion pass, and are led through a chamber in the upper lining of the generator to the snift-valve, through which they escape—the result of this being that, if the producer is kept filled with coke, you have a definite bed of fuel at the bottom of the generator heated to a high degree of incandescence, while above it you have a tall column of hot, but not incandescent, coke. This ensures that you will always have the same area of incandescence and the same area of coke at the lower temperature.

Having blown all the lower portion of the bed to the right temperature, by means of an air-blast so apportioned that the combustion is as nearly perfect as possible, by merely turning the operating gear the air-blast and snift-valve are simultaneously cut off, and tar is injected by steam into the centre of the incandescent fuel. It is there decomposed; the mixture of water gas, tar gas, and finely divided carbon being caused to pass up through the whole bed of moderately hot fuel in the upper part of the generator, which serves as a filter to collect the finely-divided soot from the gas and to bring it back as the coke burns down in the generator to the zone of combustion, where it is in turn utilized during the succeeding operations. The mixed gases, after scrubbing and cooling, are mixed with the coal gas or passed through retorts, in order to collect benzol or other vapours, as is done with the blue water gas, for which purpose, however, it is far superior.

This apparatus has now been at work for a couple of months in your gas-works, and by its aid over 4½ million cubic feet of gas have been made since the end of January. Although there still remain some slight adjustments of the air-blast and injector to be seen to, it has given ample proof that Mr. Tully's claims for it will be fully justified, and that for a consumption of a little over half-a-gallon of tar and 28 lbs. of coke 1000 cubic feet of 8-candle gas of the following composition can be obtained: Hydrogen, 58·7 per cent.; methane, 10 per cent.; unsaturated hydrocarbons, 1·3 per cent.; carbon monoxide, 23 per cent.; carbon dioxide, nitrogen, &c., 7 per cent.—the gas showing a calorific value of 395 B.T.U.

The advantages of this methane-hydrogen plant as a diluting gas in small works are considerable. The saving of ground space

is very great, while the coke and tar employed are produced at the least possible price where they have to be used, and the disadvantage found with carburetted water gas, of the process being dependent upon fluctuations in the price of the necessary oil, is done away with. The apparatus, moreover, is low as regards cost, and therefore gives an economy on capital account; and being rich in hydrogen and low in the percentage of carbon monoxide, the methane-hydrogen is an ideal gas for diluting coal gas, and, owing to the methane present, does not decrease the size of the flame to the same extent as ordinary water gas does. I can heartily congratulate your able Gas Manager (Mr. Ingram) in the wisdom he has shown in inaugurating this method of adding to the gas supply of Truro.

The lecturer then traced the evolution of the gas-burner, from the thimble first used by Murdoch to the introduction of the regenerative system; concluding his remarks under this head with the following table showing the light emitted per cubic foot of gas consumed per hour by means of different burners:—

Burner.	Candle Units.
Incandescent (high pressure)	30 to 35
,, (Kern)	20 to 25
,, (ordinary)	14 to 19
Regenerative	7 to 10
Standard argand	3·20
Ordinary argand	2·90
Union jet flat flame, No. 7	2·44
,, ,, ,, 6	2·15
,, ,, ,, 5	1·87
,, ,, ,, 4	1·74
,, ,, ,, 3	1·63
,, ,, ,, 2	1·22
,, ,, ,, 1	0·85
,, ,, ,, 0	0·59

In considering the value given to the gas by these burners, said Professor Lewes, it is seen that, according to the method by which it is burnt, the consumer may obtain anything from 35 candles down to less than 1 candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good, well-made burners, giving the best duty that can be obtained from them; while an examination of the burners used in consumers' houses shows that in most cases any antiquated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are those who most disregard the method of its consumption.

After describing the principle of the incandescent burner and the manufacture of the mantles, Professor Lewes concluded as follows: I cannot do the gas consumer a greater kindness than to impress on him the fact that the efficiency of the light which he obtains, and the healthfulness of coal gas as an illuminant, entirely depends upon himself. By means of the incandescent burner more light at a less price, and with less vitiation of the atmosphere, can be obtained than by any other form of combustible illuminant. The idea that candles and oil-lamps foul the air less than coal gas entirely depends upon the fact that when one uses these forms of illuminant one is content with a far less degree of illumination. But, light for light, they use up much more oxygen (the life-giving principle of the air) than coal gas does; and a point, although a very small one, with regard to the methane-hydrogen gas which has now been introduced in your works is that in its combustion it requires a slightly less quantity of air than coal gas—a fact which you must remember if by any chance some of the atmospheric burners in your cookers or stoves require re-adjustment from time to time. Remember that the great end and aim of your able Gas Manager is to give you every possible satisfaction, and that of necessity he must know better than you the burners best suited to develop the light from the gas which is being supplied. I must earnestly suggest that you should consult the officials of the gas office with regard to the best burners to introduce in your house lighting, and to give all your existing burners a thorough overhaul. I can promise you that if you do so Truro in the future will be far better lighted than it has ever been before.

Copper Sulphate as a Germicide.—In the "JOURNAL" for the 29th of November last, reference was made to some experiments which were then in progress in the United States with the view of determining the value of sulphate of copper for purifying water subject to contamination by algæ. It appears that Boards of Health and officials in charge of public water supplies have now been furnished with the results. A solution of 1 part in 100,000 parts is said to destroy in three hours the most virulent of typhoid and cholera bacteria, without rendering the water unfit for the use of animals or man. The method proposed may be applied to ordinary water reservoirs, or to fish-ponds, oyster-beds, &c. Large bodies of water may be sterilized in three to four hours; and it is stated to be an easy matter to eliminate the sulphate of copper introduced. It is found that the beneficial bacteria are unaffected by the solution—its selective toxicity being exercised only on the pathogenic forms. No rules are laid down as to the amount of copper sulphate to be added; each case having to be treated according to its own requirements. The cost of the material for exterminating the mischievous algæ is very low—from 50 c. to 60 c. per million gallons sufficing in the way of expenditure. For the destruction of pathogenic bacteria, the cost, apart from that of labour, is only from $5 to $6 per million gallons.

THE EFFICIENCY AND PRACTICAL IMPORTANCE OF COMMON SOURCES OF LIGHT.

By Professor W. WEDDING, of the Charlottenburg Technical College.

[Abstract Translation of a Series of Articles in the "Journal für Gasbeleuchtung."]

Nature affords three different ways of producing light. The sun, with a temperature of about 8000° C., gives a maximum lighting effect on the earth's surface of about 288,000 candles (? Hefners), and about double as much at the margin of the earth's atmosphere. This lighting depends on high temperature; and all attempts to get illumination through high temperature involve the application of the law that the development of light increases with the fifth power of the absolute temperature. Therefore, with any source of light, as soon as simple means are found to raise the temperature above that hitherto attained by even but a little, a greater development of light is secured. The phenomenon may be observed with electric glow lamps and with Welsbach mantles, with both of which small changes tending to produce slight variations of temperature afford considerable alteration in the illuminating power. Therein lies the reason for the complaints of consumers of fluctuation and inconstancy of the light.

The second way in which light is produced is displayed in nature in the fire-fly, marine infusoria, &c. This phenomenon of luminescence generally relates to the production of a light of one colour, and that green. As green is the radiation which is most economically produced, the study of this method of producing light is a promising one. Given a certain amount of energy, and assuming that the red light obtainable therefrom is represented by 1, then the yellow light alternatively obtainable would be = 28,000, the green = 100,000, and the violet = 1600. The truth underlying these figures may be realized by means of gas-mantles or electric arc carbons suitably impregnated or treated to yield lights of simple colours. But apart from any technical difficulties in the way of realizing a simple green (or other simple colour) light, it would be unsuitable for general lighting, because the eye requires a light which approximates in composition to sunlight or daylight.

The third way of light production is illustrated in Nature by the aurora borealis, and technically in Geisler tubes, the Tesla light, and the Cooper-Hewitt mercury vapour lamp. The latest efforts towards applying this way aim at converting all the energy into light, and thus secure the most economical so-called "cold" light. But their aim is at present far from attainment.

All practicable modes of lighting at the present time appear to be based on the first way—that is to say, on the production of high temperatures. These investigations are therefore limited to such "temperature" lighting, and are partly scientific and partly practical. The scientific portion deals with the conversion of the applied energy into other forms of energy by the source of light. In every source, the applied energy is partly converted into radiant and partly into conducted energy, and the radiant energy again is divided into visible radiation or light, and into dark radiation or heat. In respect of wave length, these two radiations partially overlap one another; and the share of each has to be determined in each case. The molecules of the surrounding materials (of which air is the most important) serve to carry off the conducted heat; but the speed of propagation of this heat is infinitely small in comparison with that of radiant heat, of which the ether is the medium. After the scientific investigation of these matters, the practical distribution of light from different sources, its dissemination over the illuminated area, the evolution of heat and carbonic acid, and economy, come under consideration. In all, ten common descriptions of light have been thus studied.

Former methods of measuring the portion of the applied energy which gives rise to light have been untrustworthy. The radiant energy is a very small part of the total energy with any source of light, and the visible or light radiation is only a very small part of the total radiant energy. Hence any method of estimating the light radiation by difference must be very inexact. Hitherto the available apparatus for measuring radiation has not been sufficiently delicate for direct estimations to be exact; but the work of Professors Kurlbaum and Lummer, at the Charlottenburg Imperial Institute, on the development of the bolometer has now culminated in the provision of apparatus which responds rapidly and exactly to very small amounts of energy. The bolometer consists of a very delicate resistance, through which an electrical current is passing. The strength of the current is altered if the temperature of the resistance is changed to any extent, as by the energy of radiation striking it; and there are methods of measuring very small changes of current with great precision. It thus becomes possible to determine the radiant energy with precision.

The bolometer, as used, consisted of a number of very fine narrow strips of platinum wire (0·001 mm. thick, and 2 mm. wide) carefully smoked and stretched in a small square frame so as to form a grid. Four such grids were put one close behind the other,

so that the wires in one covered the spaces in the other. The area of the exposed surface measured just 1·63 square inches. The grids served as four resistances in the experiments. The measurements were made by means of a special arrangement of Wheatstone bridges and a delicate mirror galvanometer. The measuring apparatus (which is described fully in the original paper) permitted of the measurement of the energy of radiation in watts per square centimetre. By moving the bolometer to different parts of a sphere with a radius of 1 metre from the source of light, the energy of radiation per square centimetre at the distance of 1 metre could be determined. For the most part, however, the measurements were made only in the horizontal plane. In some cases, the energy to be measured was so small that it was found necessary to put the bolometer less than 1 metre away from the source. Special researches showed that the law of squares was applicable, and the results in these cases were reduced to the uniform distance of 1 metre.

The bolometer determines directly the total radiation; but by interposing material capable of absorbing the dark or invisible radiation, only the luminous radiation is left to be measured, and only the portion of that which has not been absorbed by the material interposed. A glass vessel, with plane parallel walls, filled with clean water, was used in the experiments for the absorption of the invisible radiation. The extent to which it absorbed the luminous radiation was first determined for each source of light by means of a delicate photometer. At the same time, the intensity of the light from each source was naturally ascertained, and the ratio thereof to the energy of the visible radiation as measured by the bolometer was determined. In order to eliminate the effect of air currents in causing fluctuations in the throw of the galvanometer, a thin glass cover was placed over the mouth of the bolometer casing, and allowance made for its reducing effect, which was ascertained by separate measurements. The invisible radiation was computed as the difference between the total and the luminous radiation. The measurements were in all cases made for different angles in a vertical plane as well as for horizontal radiation from the source of light.

1.—Petroleum Lighting.

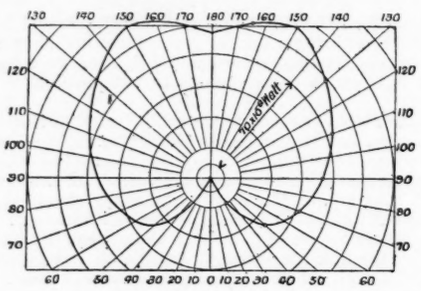


Fig. 1.

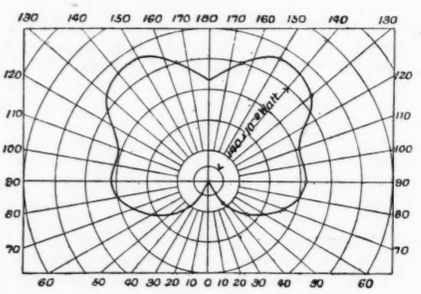


Fig. 2.

The petroleum lamp was investigated because of its widespread use in all civilized countries. The measurements were made on a so-called 14-line normal burner, as made by the firm of Wild and Wessel. This lamp, with its chimney, gives an illuminating power of about 13 candles in a horizontal direction. Directly downwards there is no radiation, owing to the reservoir and burner screening it off. Values which can be measured are not obtainable below, until an angle of about 35° to the vertical is reached. Measurements were made at this angle, and thence at intervals of 15° or 20° up to an angle of 165° (15° to the vertical upwards). The values found have been plotted out as functions of the respective angles, and the diagrams figs. 1 and 2 were thus obtained. Fig. 1 refers to the total energy of radiation, and the concentric circles (except the inner one) are equally spaced, so that the distance between any two adjacent circles represents 20×10^{-6} watts per square centimetre. The curve in this diagram shows the value of the total radiation in these terms for any angle. Thence the mean spherical radiation at a distance of 1 metre from the source may be calculated. After all corrections had been made, the value of this mean spherical radiations was found to be $113{\cdot}4 \times 10^{-6}$ watts per square centimetre.

Fig. 2 shows similarly the curve for the distribution of the luminous radiation. The concentric circles (except the inner one) in this figure are spaced so that the distance between any two adjacent circles represents 40×10^{-8} watts per square centimetre. The mean spherical luminous radiation at 1 metre from the source was calculated to be equal to $1{\cdot}327 \times 10^{-6}$ watts per square centimetre. The difference between this value and that found for the total radiation gives the mean invisible or dark radiation as equal to $112{\cdot}1 \times 10^{-6}$ watts per square centimetre. Thus, in the petroleum lamp, the ratio of visible to invisible radiation is about 1 : 100. It further follows from fig. 2 that the light radiated above the horizontal plane is about double that radiated below that plane, or more exactly as 75·6 : 38·6.

The lamp consumed petroleum at the rate of 43·6 grammes per hour, or 0·0121 gramme per second (1·54 oz. per hour). The efficiency of the lamp can be calculated from these data, and the calorific power of petroleum, which may be taken at 11,046 calories per kilogramme, or 19,883 B.T.U. per lb. The consumption of oil represents an expenditure of 557·4 watts; and regarding this as uniformly distributed on the surface of a sphere of a radius of 1 metre, the amount expended per square centimetre at a distance of 1 metre is found to be $44{\cdot}36 \times 10^{-4}$ watts. The efficiency of the petroleum lamp—that is, the ratio of light energy produced per second to the energy of the petroleum consumed per second—then is

$$\frac{1{\cdot}327 \times 10^{-6}}{44{\cdot}36 \times 10^{-4}} = 0{\cdot}03 \times 10^{-2}.$$

The lamp develops in the horizontal direction, at a distance of 1 metre and per square centimetre, a visible radiation of $134{\cdot}3 \times 10^{-8}$ watts and 14·8 Hefners. Therefore the lamp affords for 1 watt visible radiation 11,000,000 Hefners (about 9,650,000 English candles).

The incandescent petroleum lamp is so unsatisfactory, except perhaps in skilled hands, that it has not seemed necessary at present to extend the investigation to it.

2.—Incandescent Spirit Lighting.

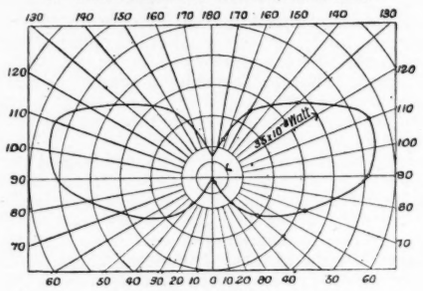


Fig. 3.

The researches on this mode of lighting were made with a lamp supplied by the German Incandescent Gas-Light Company. It was of the type having a gasifier and a separate heating flame. 95 per cent. spirit, prepared by a Charlottenburg house and having a specific gravity of ·856, was used. Its calorific value was 5415 calories gross and 4776 calories net per kilogramme (9747 B.T.U. gross and 8597 B.T.U. net, per pound). The lamp consumed 128·9 grammes of spirit per hour; and the illuminating power horizontally was 65·3 Hefners (57·3 candles). The radiation was measured for different angles at intervals of 20°. The luminous radiation in all directions is shown by the curve in fig. 3, in which diagram the concentric circles (except the inner one) are spaced so that the distance between any two adjacent circles represents 10×10^{-8} watts per square centimetre. The light radiated above the horizontal plane is to that radiated below as 84 to 48, or nearly double. The value of the mean spherical total radiation was found to be 183×10^{-6}, and that of the mean spherical luminous radiation $0{\cdot}404 \times 10^{-6}$ watts per square centimetre. The spirit consumed represents an expenditure of 713 watts, or a mean spherical expenditure of $56{\cdot}75 \times 10^{-4}$ watts. The efficiency of the spirit lamp therefore is $= 0{\cdot}00712 \times 10^{-2}$. In a horizontal direction, the lamp affords, at a distance of 1 metre, a luminous radiation per square centimetre of $53{\cdot}1 \times 10^{-8}$ watts, and a light of 65·3 Hefners. Hence the lamp affords for 1 watt visible radiation 106,000,000 Hefners (93,000,000 candles). This is a very much higher effect than that obtained from the petroleum lamp; being about eleven times as great. This is due to the light of the incandescent spirit lamp being rich in green rays, while the petroleum light is rich in red.

3.—Incandescent Gas Lighting.

(A) *Ordinary Upright Burner.*—It has gradually been recognized that both the type of burner and the mantle are of the utmost importance in order that the best results may be attained in incandescent lighting. In the burner it is essential that the right proportions of gas and air should be secured, and, further, that the gas and air should be intimately mixed. But a non-luminous flame, with inner and outer parts, which serves for heating purposes, is not so well suited for raising a mantle to incandescence. For the latter purpose, the aim must be to produce a flame having only one part or mantle, which shall as nearly as possible be in intimate contact with the refractory mantle.

Any of the flame which is right within or is outside the mantle is valueless. Much has been done to improve the mantles, both in respect of illuminating quality and durability; but a great deal depends on the workpeople engaged in producing them, and mantles from the same factory may vary greatly in quality. For much domestic lighting, an improvement in the lighting value of the ordinary mantle is less desired than a reduction in its size with a corresponding reduction in the quantity of gas consumed. Small mantles are more durable than large ones, and in many interiors the light given by the early burners amply suffices. Great advances have been made of late in the production of high-power incandescent gas-burners for the lighting of large spaces. These burners will be considered later.

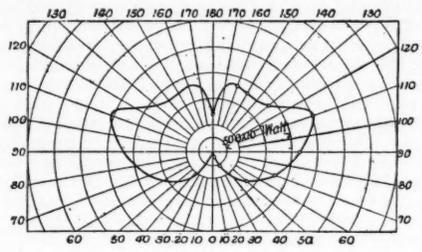


FIG. 4.

The investigation of efficiency was carried out with an incandescent burner with a new mantle, which was burnt for a few hours, carefully adjusted. The consumption of gas per hour was 112·3 litres (corrected to 0° C. and 760 mm.) = 4·19 cubic feet at 60° Fahr. and 30 inches. The light in a horizontal direction was equal to 73·8 Hefners (64·7 candles). The energy radiated at different angles was determined as in previous cases. The results for the total radiation are shown in the curve in fig. 4, in which diagram the concentric circles (except the inner one) are spaced so that the distance between any two adjacent circles represents 200×10^{-7} watts. The curve in fig. 5 shows diagrammatically the luminous or visible radiation. In this diagram, the concentric circles (except the inner one) are spaced so that the distance between any two adjacent circles represents 20×10^{-8} watts. It will be seen from the curve that the maximum value is attained at about 20° above the horizontal, and that the most favourable results are not obtained by the ordinary mode of measuring the illuminating power in a horizontal direction. The corrected values for the mean spherical radiation at a distance of 1 metre per square centimetre are $90{\cdot}35 \times 10^{-6}$ watts for the total radiation, and $0{\cdot}961 \times 10^{-6}$ watts for the luminous radiation.

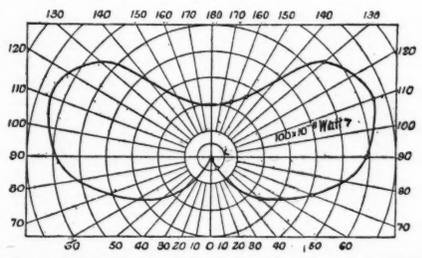


FIG. 5.

The ratio of the luminous energy developed above the horizontal plane to that developed below it is as 1·73 to 1; so that, as might be expected from the shape of the mantle, by far the greater part of the light is developed upwards. Hence reflectors, &c., must be employed to secure a rational utilization of the light on surfaces below the burner. On the other hand, the distribution of the light renders the incandescent gas-burner specially suitable for indirect or diffused lighting. The efficiency of the incandescent gas-light, assigning to Charlottenburg gas a calorific power of 5100 calories per cubic metre (573 B.T.U. per cubic foot), is = 0·000182; so that not 0·02 per cent. of the energy employed is converted into light. For the production of 1 Hefner, 0·017 $\times 10^{-6}$ watts are consumed, which very low consumption is to be attributed to the highly green radiation. With complete conversion, 1 watt would thus give a light of 60,000,000 Hefners (52,620,000 candles). Unquestionably great as are the results of incandescent gas lighting, practically and industrially, it cannot be considered scientifically to constitute an advance in the production of light by a more rational conversion of the applied energy into light energy. The conversion is bad in the same way as with the sources of light previously considered.

(B) *Inverted Gas-Burner.*—The inverted burner constitutes a special advance in incandescent gas lighting in that it lights surfaces below it without any shadow. It is too early yet to say what its ultimate position will be; but it has already made its mark. There are several competing inverted burners; and a large number of firms (in Germany) put more or less bad ones on the market. The responsibility for the existence of these indifferent products lies mainly with gas men, who, as a body, fail, through ignorance of physical laws or otherwise, to discriminate between the bad and good burners of this class. The author has examined many patterns of inverted burners, and up to date (the early part of 1904) has found that of Dr. Kramer the best.

The notion of an inverted burner is tolerably old; for in 1886 Gallopin patented, in America, such a burner, using a fine platinum wire mantle, and consuming hydrocarbon gas. The next year, patents for coal-gas burners were taken out. But they had no practical significance until Bernt and Cervenka, of Prague, took out their patent for a burner of which the mixing tube was made of porcelain and tapered upwards. Kramer's burner was introduced in 1903, and is on different lines. He uses a metal mixing-tube, which becomes heated, and thereby effects a preliminary warming of the gas. Experiments were made with a special burner, with a water-jacketted mixing tube, to ascertain the effect of raising the temperature of that tube on the action of the inverted burner. The light issuing from the burner at a constant angle was determined when the water-jacket was kept at different temperatures, which were read on a thermometer inserted in it. With water flowing through the jacket, a constant temperature of 22°C. was reached, and the illuminating power was 25 Hefners (21·9 candles), while the light was unsteady. The burner was consuming 2·08 cubic feet of gas per hour at a pressure of 18-10ths, and the illuminating power was measured at an angle of 38·5° to the horizontal. On cutting off the water from the jacket, the temperature gradually rose up to 100°C. At 60°C., the light became steady, and equal to 39 Hefners (34·2 candles); and these conditions remained without substantial change while the temperature rose to 100°C. Preliminary warming effected practically a doubling of the illuminating power obtained, and steadied the light. The degree of preliminary warming required depends on the gas consumption and proportions of the burner.

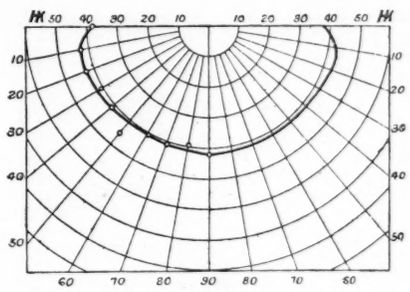


FIG. 6.

The Kramer inverted burner was used in the tests on the distribution of radiation, both with and without a corrugated porcelain reflector, at a gas pressure of only 11-10ths. The measurements of light evolved without the reflector and with clear glass, at different angles, give as a mean the values indicated by the curve in fig. 6, in which diagram the concentric circles are spaced so that the distance between any two adjacent ones represents 10 Hefners (8·77 candles). By integrating and measuring the area enclosed, the value of the mean hemispherical illuminating power for the lower hemisphere is found to be 42 Hefners (36·8 candles). The consumption of gas was 2·1 cubic feet per hour which gives 17·5 candles, hemispherically, per cubic foot consumed. With the corrugated porcelain reflector, the curve shown

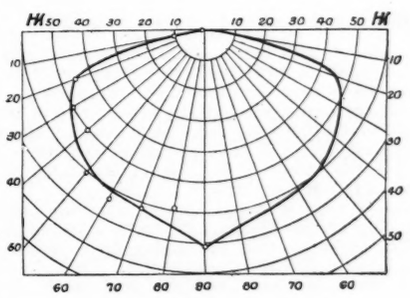


FIG. 7.

in fig. 7 was found. It will be seen that with this reflector practically no light is emitted horizontally, while the light is concentrated below, and reaches a pronounced maximum, which is undesirable for practical purposes, because it conduces to want of uniformity of illumination of surfaces. The reflector serves no purpose with the inverted light, unless it be a decorative one. Measurements of the distribution of energy were not made specially for the inverted light, because the results that were found for the ordinary incandescent gas light are applicable to the inverted light also.

(To be continued.)

WEST'S SELF-ADJUSTING RETORT-CHARGING MACHINE.

Among the patent specifications recently issued is one for an arrangement of retort-charging machine in which the application of a coal-hopper, supported on springs or balance gear, acts not only as a weighing machine for ascertaining the weight of coal deposited in a hopper, but for starting and regulating the supply of power to the motor that drives the charging apparatus, the speed of which is increased when the hopper is at its lowest level and full of coal, and is gradually reduced when the hopper rises through emptying itself. There is also described an ingenious arrangement of outlet passage, with hinged sides and division plates, for directing the coal as it leaves the propelling-drum blades towards the centre or sides of the retort, for the purpose of effecting a level charge through its entire length and width.

In the words of the patentee, in his specification, the invention relates to the charging of coal into retorts by a machine (which travels along a rail-path laid parallel with the front of the retort-settings) consisting of a trolley supporting a coal-hopper and charging apparatus constructed for throwing the coal into the retorts and distributing it "in an even depth in thickness and of the full length of the retort." The coal-hopper on the charging machine is supplied with coal either from one or any number of hoppers fixed overhead in the retort-house and provided with bottom outlets fitted with slide-doors which, when opened, allow the coal to fall by gravity into the hopper on the machine.

Hitherto fixed overhead coal-hoppers for the supply of retort charging machines have usually been constructed, the patentee remarks, with slide outlet doors fitted with a separate set of hand-levers for each outlet; but in this invention, the charging machine is provided with one set of levers common for opening one or any one of the slide doors—the latter being provided with a projection in which the levers on the machine will engage when the machine is directly below the slide door of the overhead hopper from which the supply of coal is to be obtained. Hopper levers which are carried on the machine will, therefore, open and close the slide doors of the overhead coal-hopper outlets.

The coal-hopper on the charging machine in this invention serves several important purposes. It receives from the overhead hopper or hoppers the quantity of coal required for charging a retort, and is supported on springs or other balance gear which enable the hopper to fall to a lower level when it is loaded with coal, and rise when the hopper is empty. The range of fall is regulated by the strength of the springs which support the hopper. The rise and fall puts into motion levers or springs connected with a weight-recording apparatus, with a dial indicating the weight of coal contained in the hopper; but the most important function caused by the fall or lowering of the hopper due to the emptying of the coal during the operation of charging a retort is the regulating of the speed of the charging apparatus. This requires to be working at maximum speed at the commencement

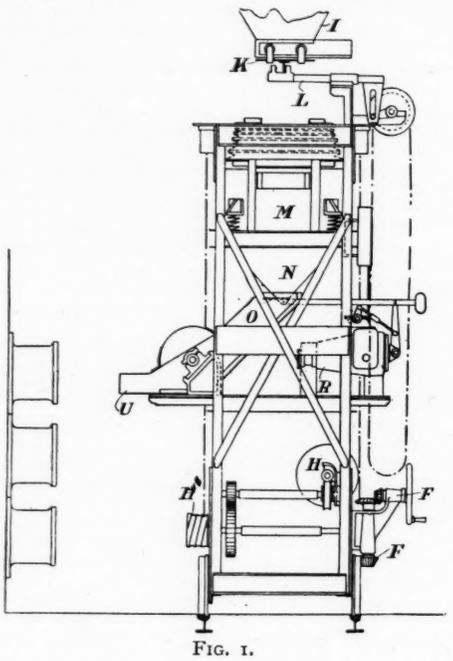


FIG. 1.

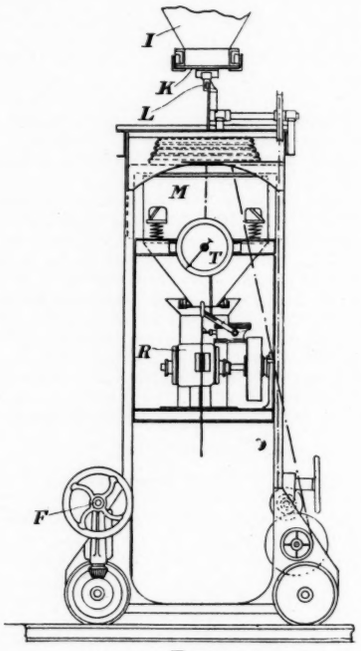


FIG. 2.

and during the first part of the charging; the speed reducing as the charging proceeds, until (at the completion of the charge) the charging apparatus is running at its minimum speed. The regulation of the speed of the charging apparatus is accomplished by levers connected to and between the coal-hopper and a speed regulator in connection with the driving motor or other suitable driving gear which may be adopted for the purpose of driving the charging apparatus, so that the fall or rise of the hopper imparts motion to the levers and regulates the speed of the charging apparatus to suit the size and distance the coal has to be thrown into the retort and the amount of coal that is required to be delivered into the retort.

At the base of the coal-hopper on the charging machine is a slide door, which, when opened, enables the coal to fall down an inclined plane shoot towards a revolving drum provided with a number of blades radiating from its centre. These blades receive the coal as its falls down the inclined plane shoot from the hopper, and carry it forward through a portion of a revolution of the drum when the latter imparts to the coal a velocity which causes it to leave the blades and enter the retort. But before doing so, the coal passes through an outlet passage placed immediately in front of the revolving drum. This outlet passage is so constructed that it diverts the direction of the stream of coal ejected from the blades of the drum and causes it to be finally deposited in the retorts in an even depth throughout the entire length and width of the complete charge of coal.

The construction of the outlet passage in front of the revolving drum is an important part of the invention, as it enables the stream of coal to be altered in shape and direction during the operation of charging the retort. In front of the revolving drum, the outlet passage is constructed of rectangular shape; but the sides are hinged at points near the drum, and are provided with levers to enable the sides at the outlet end of the passage to approach towards, or recede from, each other in order to contract or enlarge the orifice at this part. Consequently, when passing through the part where the orifice is contracted, the stream of coal is concentrated towards the centre of the retort; and when the sides are opened, and the orifice widened, the coal is directed towards the sides of the retort.

In addition to the adjustable hinged sides of the outlet passage in front of the revolving drum, there is a central division constructed of two plates in the form of a V on plan; the thin end of the section being placed nearest to the revolving drum. These plates are provided with levers connected with the levers operating the movable sides of the outlet passage, so that when the front ends of the sides are closed in so as to contract the opening, the plates forming the V division are caused to close towards each other. The central division therefore when open assists in directing the coal towards the sides of the retorts and when closed offers little or no resistance to the passage of the coal from a straight line. The levers for actuating the sides of the outlet passage and the division plate of the same are set in motion by the fall and rise of the coal hopper and so adjusted that when the hopper is full, the front of the outlet and the V division are contracted.

Figs. 1 and 2 are elevations of a machine supported on wheels to run along rails laid in the retort-house floor.

Figs. 3 and 4 are elevations of a machine supported on wheels to run along rails fixed overhead and suspended from girders spanning between the retort-bench and the retort-house walls, or from girders supporting overhead fixed coal-hoppers.

Figs. 5 and 6 are elevations of a machine supported on wheels

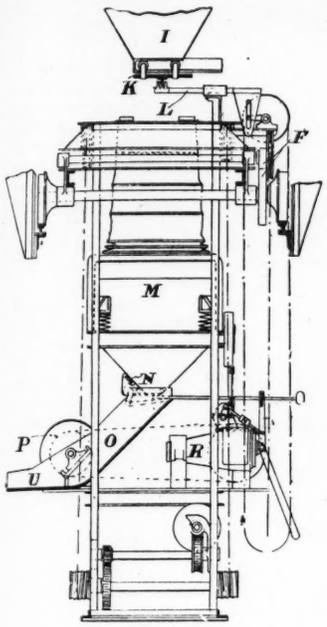


FIG. 3.

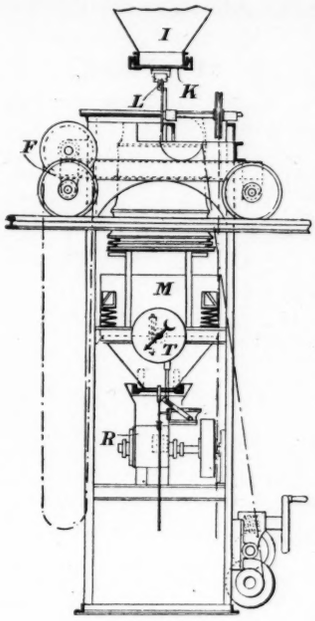


FIG. 4.

to run along rails laid in the retort-house floor—this arrangement of machine embracing a hopper for storing a quantity of coal to enable a number of retorts to be charged before the hopper is replenished with coal from the overhead fixed coal-hoppers.

Fig. 7 shows elevations of the coal-hopper of the charging machine; the arrangement of springs for supporting the coal-hopper and weighing the coal; and the dial indicating the weight of coal contained in the hopper. These views also show the general arrangement of the hopper slide outlet door, the shoots for feeding the coal from the hopper to the revolving drum of the charging apparatus, and the motor and driving gear for revolving the drum.

Fig. 8 is a sectional elevation (enlarged) of the slide outlet door of the coal-hopper on the charging machine. It also shows details of the door regulating the size of the outlet opening, which is adjustable to suit the size and quantity of coal to be put into retort.

Fig. 9 shows end elevations, side elevation, and plan (enlarged) of the charging apparatus with the outlet passage having hinged sides and central division plates for directing the stream of coal into the retorts and depositing it there "in the form desired for proper carbonization."

Fig. 10 shows the position of the hinged sides and division plates of the outlet passage during the time the first portion of the retort is being charged with coal; and fig. 11 shows their position during the completion of the charge.

The machine is supported on wheels which travel along rails laid either in the floor of the retort-house or else suspended from girders above. E (figs. 5 and 6) is a motor and gearing for travelling the machine along the rails, and raising or lowering the charging apparatus, or the machine may be fitted with hand propelling gear F (figs. 1 to 4). I is the fixed overhead coal-hopper, from which the charging machine obtains its supply of coal. J is a fixed coal-hopper on the machine when this is constructed in the form to carry a supply of coal for a number of retorts (as figs. 5 and 6) but not required when a fresh supply of coal is received from the overhead hoppers at each retort. There is an outlet slide door to the overhead hopper, with a projection on it in which a connecting rod L of the levers for opening and closing the door engages when the machine is directly underneath the outlet to be opened.

The arrangement for giving reciprocating motion to this connecting rod enables the machine attendant, by pulling a chain, to open or close any of the slide doors of the overhead coal-hopper below which the charging machine happens to be when receiving its supply of coal.

M is the coal-hopper on the charging machine; and springs are provided on which the hopper is supported, with a sliding door at the base and a hand connecting rod for opening and closing the door. N is a flap-door working on a hinged pin, which is caused, by the action of the lever for adjusting the position of the door, to slide up and down the slot in the slotted plates; a lever engaging with the flap-door being fixed to a shaft which has a lever and hand connecting rod placed in a convenient position for the machine attendant. The object of the flap-door is to regulate the width of the outlet door opening of the hopper M. By the action of the levers, the width of the opening is either increased or decreased; and the slotted plates for the hinged pin enable the bottom edge of the flap-door to keep close to the slide door. The area of the outlet from the hopper M is adjusted by the flap-door to suit the coal; the slide door always opening to its full extent.

O is a shoot which receives the coal falling through the outlet of the hopper, and directs it to the propeller plates of the drum P, which revolves in the direction away from the retort-bed. Q is the driving pulley on the drum shaft, driven by a belt from a pulley and motor. The motor shown is a compressed air driven motor; but for the purpose of the invention the motor may be driven by steam, gas, or electricity.

The speed of the motor and the charging apparatus is regulated automatically by the hopper M actuating an auxiliary valve in a machine in which the drum P is driven by a compressed air driven motor, because the valve is opened in relation to the amount of coal contained in the hopper M. Therefore, when the hopper is full and the starting valve has been fully opened, the hopper is in its lowest position, and the auxiliary valve is full open. The supply of compressed air will then be sufficient to enable the motor to run at full speed. But as the coal-hopper empties itself during the operation of charging a retort, the hopper rises, the air supply is gradually cut off, and the speed of the motor reduced. This automatic regulation of the speed in relation to the weight of coal contained in the hopper is important to enable a retort to be charged evenly throughout its entire length, and the auxiliary valve can be adjusted to suit the distance the coal has to be thrown into the retort.

In a machine driven by an electrically driven motor, the auxiliary valve is replaced by a speed regulating rheostat, which controls the speed of the motor. The rheostat is actuated by the hopper M, as described for the auxiliary valve.

In order that the machine attendant may know the weight of coal contained in the hopper, an indicator dial T is fixed on the machine; the hand or finger of the indicator being rotated by the rise and fall of the hopper to which the mechanism driving the indicator is connected.

U is an outlet passage (immediately in front of the drum P), with hinged radiating sides coupled together by a connecting rod and levers, so that both sides are operated simultaneously.

A lever V is fitted to one of the outlet passage sides; and by

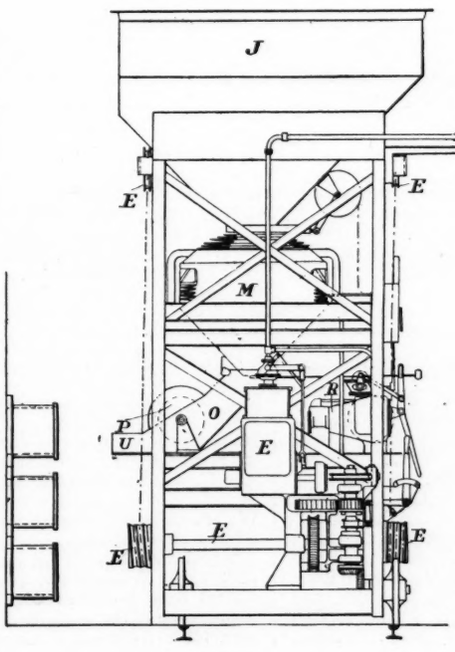


FIG. 5.

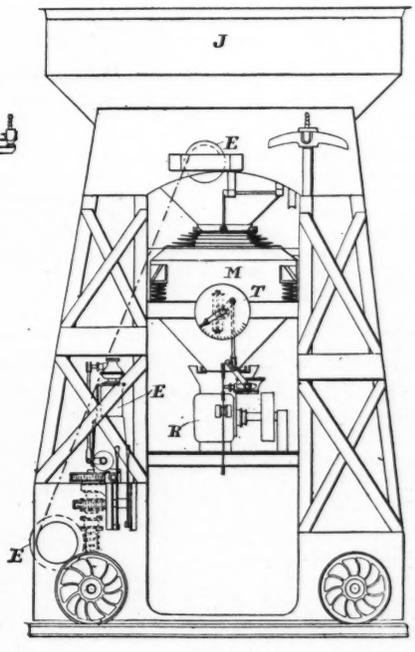


FIG. 6.

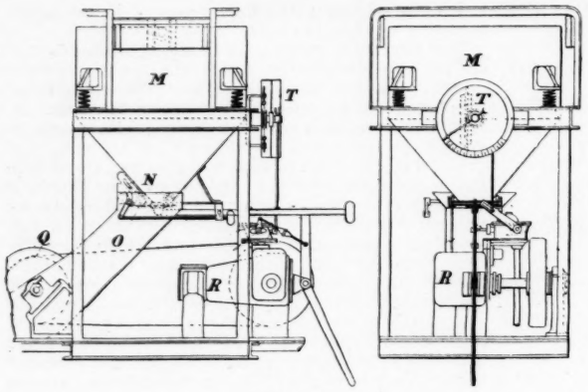


FIG. 7.

means of a connecting rod and lever, it is coupled to a trip or catch lever which is so arranged that it may be put into a position to enable it to be operated by a vertical rod fitted to the hopper M. This vertical rod releases the trip or catch lever at a certain time during the operation of charging a retort; and a weighted lever causes the outlet passage sides to assume the position shown on the sketch fig. 11. After the retort is charged with coal, the hinged sides are replaced in the position shown in fig. 10, and this is accomplished with the rod W, which is connected with the levers of the hinged sides, and may be either operated by the machine attendant or automatically by the hopper M when the

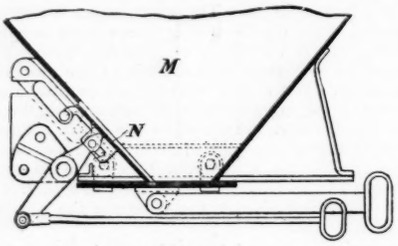


FIG. 8.

latter is being refilled with coal. X is a central division in the outlet passage U. It is of the full depth of the passage and constructed of two plates fastened together at, and radiating from, a single point. The other ends of the plates, being free to approach to, or recede from, each other, form a contracting or expanding division plate, which will assume a form in the shape of a V on plan when the ends are expanded.

The operation of charging a gas-retort is thus described by the patentee: By means of the travelling and adjusting gear, the machine is placed opposite the retort to be charged. The attendant then, by pulling a chain, opens the slide door K of the overhead coal hopper I, and coal is permitted to fall by gravity into the hopper M on the machine. As this hopper fills, the springs are compressed, and the hopper, which is supported on them, falls to a lower level. The amount of fall is indicated on the dial of the indicator T. Having obtained the weight of coal required for the charge, the attendant then closes the door K, and opens the slide door below. This increases the speed of the motor R and the drum to that required for throwing the coal into the retort. At the same time the coal falls from the hopper M and down the shoot O to the propeller blades, which receive and throw the coal through the outlet passage U and into the retort. At the commencement of the charge, the hinged side plates and division plates are in the position shown in fig. 10; but after the retort has been partly charged they assume the position shown in fig. 11. The coal is thus delivered to the sides of the retort; and "the retort will then be completely charged with an even layer of coal throughout its entire length." This result, more especially in long retorts, would not have been attained had the outlet passage been constantly of the shape shown in fig. 10.

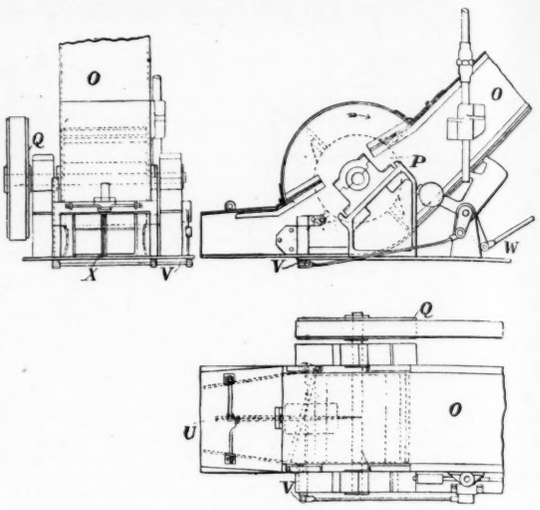


FIG. 9.

During the process of charging the retort, the mcchine is automatically regulating the speed of the drum P by the speed-regulating gear operated by the rising of the coal-hopper as the latter is being emptied of coal. The flap-door N is operated and regulated by the machine attendant to suit the depth of coal.

The foregoing description applies to machines arranged as in figs. 1 to 4; but in machines as in figs. 5 and 6 (having a coal-hopper containing a supply of coal for a number of retorts), the slide door will be fitted to this hopper instead of to the hopper I, although the arrangement for opening and closing the doors of overhead coal-hoppers for supplying this machine may be the same as in the machine shown in figs. 1 to 4.

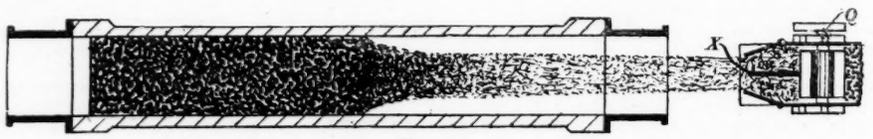


FIG. 10.

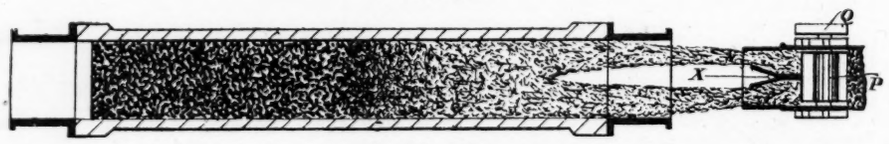


FIG. 11.

Assistance for Naphthalene Investigation from Across the Sea.

Those of our readers who had the good fortune to share in the greetings and events of the day when gas engineers from the Continent and our far-away Dependencies were the guests of the Institution of Gas Engineers at the Earl's Court Exhibition, will remember that one of the distinguished visitors was Mr. R. O. Thompson, the Chief Engineer of the Melbourne Gas Company; and not only on that occasion when the evidence of the universality of the gas profession was conspicuous, but on all others wherever our friend from the Antipodes went, he was most cordially received by his colleagues. Shortly after the exhibition, he returned home by the P. and O. steamship *Mongolia*, and resumed his duties in February. One of his first acts shows that the pleasant experiences among, and welcome by, his professional friends in the Old Country had not been blotted from memory by his long voyage; for a letter has lately been received from him by Mr. Douglas H. Helps (who was last year President of the Southern District Association) announcing a subscription of £20 from the Melbourne Gas Company to the naphthalene research fund. "The Directors," writes Mr. Thompson, "realizing the kindness shown to me by yourself, as well as by the members of the Southern Association, and the good work done by the Naphthalene Committee, directed that the sum of £20 be handed to your Secretary by our London Agents in aid of naphthalene research." We are quite sure that those who are directing this inquiry, and all who have subscribed to the fund, will greatly appreciate this thoughtful and kindly act on the part of Mr. Thompson and his Directors. When the Board of a Gas Company over 11,000 miles distant from London recognize, in so substantial a manner, the importance of the work the Southern Association have in hand, it may not be too much to expect those controlling gas undertakings nearer at hand may be not only ready but anxious to follow such an excellent example.

AN IMPROVED WASHING OR SCRUBBING OR ENRICHING APPARATUS.

Browne and M'Kinlay's Patent.

Among the specifications issued last week from the Patent Office was one (No. 16,427) dated July 25, 1904, for "Improvements in Apparatus for Subjecting Gases or Vapours to the Action of Liquids or Liquid Agents or Vapours therefrom, especially applicable for Washing or Scrubbing or Enriching Illuminating or other Gases and for 'Recovery' Purposes." The patentees are Mr. A. F. Browne and Mr. Robert M'Kinlay, the foreman of mechanics at the Vauxhall Gas-Works; and they explain that the above definition of their invention is intended to include the effecting of chemical reactions or physical changes by liquid agents, by agents in solution, and by agents mechanically mixed or suspended in liquids.

The apparatus described comprises a travelling reticular, open-work, or chain-like diaphragm adapted to present itself one or more times for the passage of the gas through it, and to be continuously or intermittently travelled through the liquid agent so as to be saturated or washed or re-wetted. The diaphragm may also be maintained in the wetted or coated condition by additional supplies of liquid fed to it in any suitable manner—as, for instance, by one or more elevators consisting of endless chains or bands fitted with cups or vessels adapted to raise and discharge the liquid agents over the screen or diaphragm. The endless chain or band may also be formed of reticular or open-work metal or material, and serve as additional wetted surfaces through which the gas is to be passed.

In fig. 1, a travelling flexible diaphragm A is mounted within a casing of triangular form in section. The diaphragm is travelled over and actuated by a drum C at the apex, and passes around and over two other rollers D in the base of the apparatus—a tank filled to a suitable level with liquid agents. Outside the travelling diaphragm, and between it and the walls of the casing, are disposed, one on each side, two travelling elevators G, consisting of chains or bands fitted with buckets spaced apart, and covering the depth and breadth of the diaphragm. The lower end of the elevator dips into the liquid, and preferably extends down into the recessed portions of the base so that the buckets act as means for stirring and mixing the liquid. The driving-drum at the apex is fitted with a hood H fitting partly over it to prevent short-circuiting of the gas. It also forms part of the casing top so that the diaphragm and elevators will be accessible.

If required, the diaphragm A may be led through a liquid seal at the top of the apparatus by means of suitable rollers—as shown in the separate detail view. In this form, the driving-drum C is replaced by three rollers, one of which constitutes the driving-drum; the central roller being immersed in a channel which

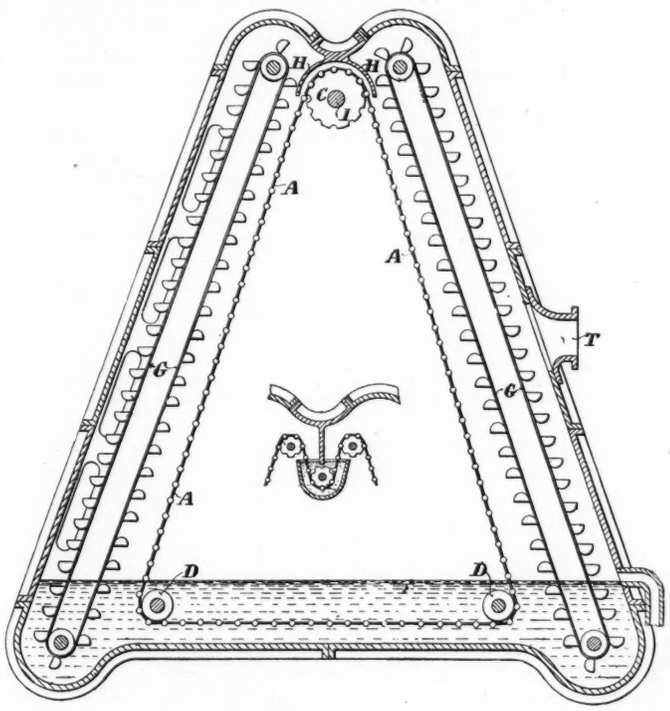


FIG. 1.

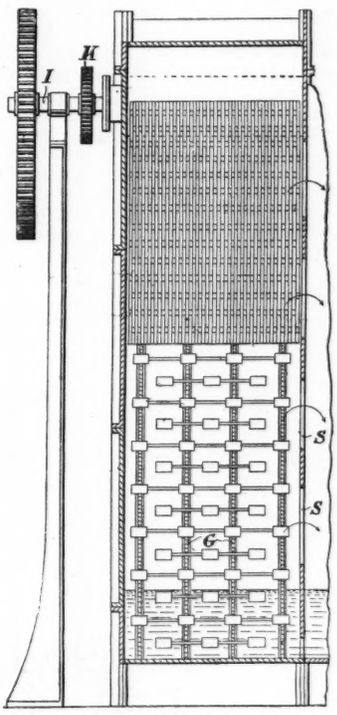


FIG. 2.

contains the liquid forming the water-seal divided by a seal-plate. This arrangement may be suitable for some purposes; but the construction shown in fig. 1 is generally preferable because of its simplicity. The closeness of the hood will generally be enough to ensure a sufficient contact of any passing gases with the diaphragm.

The driving-drum of the diaphragm and the driving drums or rollers of the elevators are rotated by external shafts and gearing, as shown in fig. 2, where I is the shaft of the drum C extending out through a stuffing-box fitted to the casing. A spur-wheel drives the shaft. One of the rollers is driven from the shaft through gear-wheels K, and the other roller on the opposite side may be driven by a chain as shown, or otherwise conveniently from the wheels K. The whole of the driving-drums of a set of apparatus may be fitted upon one shaft, or some means provided whereby the drums or their shafts will be readily coupled endwise to the other when the apparatus are assembled. The apparatus may be divided into units, in which case each unit will preferably comprise two such chambers as shown in figs. 1 and 3 having two flexible diaphragms and four sets of elevator chains and buckets—each unit being divided into halves by a fixed partition, which carries the inner bearings of the drums and shafts.

The apparatus may be used in separate units, or the process may be carried out through a series of units; or two or more units may be employed to carry out different and distinct processes, a continuous process of treatment, or otherwise as required.

Fig. 2 shows an apparatus consisting of a number of chambers employed together; and fig. 4 shows an arrangement where three separate units 1, 2, and 3 are employed each coupled separately by valves L M to a common supply and discharge conduit O—a valve being disposed at N in the discharge conduit between the valves L and M. With this arrangement, the whole or any one of the units 1, 2, and 3 may be employed when required.

In the modified arrangement, such as shown in fig. 3, by the employment of an idle drum Q and an increased length of diaphragm, it is possible so to direct the diaphragm A over the pulleys that it passes four times across the path of the gas, and so presents a great increase of surface to it in one apparatus. This arrangement is shown in full lines; and by a further modification which is shown in dotted lines in the same figure, two extra rollers are employed on the base of the diaphragm whereby it is caused to remain longer in contact with the liquid than in the arrangement shown in full lines.

In operation (referring more particularly to fig. 2), the gases are led by an inlet T into one side of the apparatus, and brought into intimate contact with the liquid in passing through the travelling diaphragms A. They then pass out at the opposite side through apertures S into the adjoining chamber, and so on through any number of chambers—leaving the last by the outlet T^1. In the course of one revolution, the whole of the surface of the diaphragm is brought into contact with the liquid contained in the reservoir at the bottom of the apparatus and immersed in it to a suitable depth. The result is that at each immersion the diaphragm is washed afresh from bodies adhering to it which may

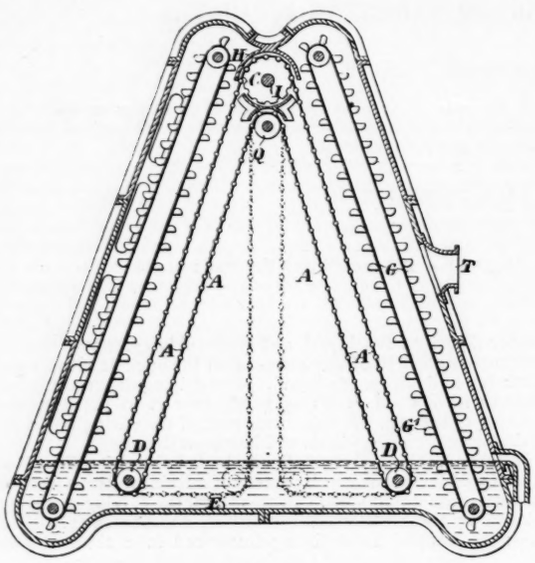


FIG. 3.

be in a partially spent condition, and then carries up upon its surfaces and within its interstices to meet the gases, the path of which it obstructs, a new supply of the bodies and materials with which the gases are to be washed. The construction of the flexible diaphragm is such as to enable it to carry or convey as large a quantity of the agents as possible; and the diaphragms (as described) present "considerable advantage over a solid or continuous surface because by reason of the constant motion of all the elements of the chain or other jointed construction and the movement of one element in regard to those adjoining causes any deposit on the diaphragm to be loosened, and, consequently, it is more easily dislodged when the diaphragm passes through the liquid." This action is said to be particularly effective where the diaphragm passes over the rollers and drums—due to the bending of the diaphragm at this place. Thus, in the words of the patentees, the diaphragm is maintained in a state of efficiency, and does not become easily clogged as would be the case with a surface of a different nature, such as has been employed in washing apparatus hitherto made. The resistance offered by the diaphragm to the passage of the gas is very small; hence the units may be multiplied without the disadvantage attaching to the heavy pressure or resistance occurring in machines or apparatus hitherto used for achieving like results.

This invention, as already mentioned, primarily relates to the purifying of coal gas and other combustible gases by washing and scrubbing, which terms assume the employment of liquids and agents in solution. But the invention further extends to the use of reagents in the form of solid particles mixed and suspended in liquids and forming mixtures more or less vescid—such, for instance, as a mixture of lime and water, "cream of lime," or "flowers of sulphur" in a liquid. The invention is designed to effect chemical reactions between bodies existing in the gaseous or vaporous state and other bodies existing in the liquid state, or in the condition of solution in a liquid, or of mechanical suspension in a liquid. The chemical reactions thus effected are not confined, the patentees point out, to the processes of the purification of coal gas or other combustible gas, but embrace any reactions in which gaseous or vaporous bodies are to be brought into intimate contact with liquids, with bodies in solution, or with solid bodies or particles in mechanical suspension in liquids, with such objects as the following: 1. For the purpose of imparting to such gases or vapours bodies derivable from such agents. 2. For the purpose of separating from such gases or vapours bodies removable by such agents. As regards the liquids to be employed in connection with the invention, they say that such liquids may be used for purposes not strictly chemical but rather physical or mechanical—such as washing by water, or such as the evaporation of liquids into the gases and vapours with which they are brought into contact. Thus the vapours of volatile bodies may be imparted to, and intimately mixed with, the gaseous or vaporous bodies passing through the apparatus.

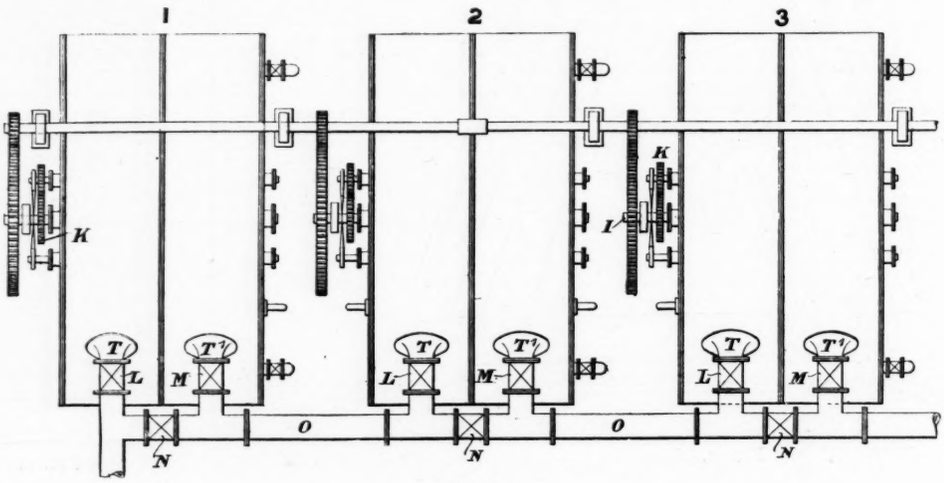


FIG. 4.

PRODUCTION AND USE OF POWER GAS.

At a recent Meeting of the Manchester Association of Engineers, a paper on "Power-Gas Plants and Some of their Uses" was read by Mr. T. RIGBY, who is a member of the staff of Messrs. Crossley Bros., Limited. The following are the portions of the paper of special interest to our readers.

The author began by referring to the great strides made during the past few years in the use of gas-engines for all classes of work, and pointed out that it is owing to this fact that plants for supplying these engines with power gas have been brought into extensive use. The systems adopted for producing this gas are three—viz., the coal-gas, water-gas, and producer-gas processes; the latter being, in the author's opinion, the best, as with it a high heat efficiency is very easily attainable. Mr. Rigby gave to Mr. Emerson Dowson the credit of having made the first successful power-gas plant, which was primarily designed to work with anthracite fuel; but he has also used gas coke, when this has been found free from tar. A great number of these plants are working in different parts of the world, although, Mr. Rigby said, they have never found very great favour in certain parts of England, owing to the fact that anthracite is very expensive (unless obtained close to the mines) as compared with the plentiful supply of common bituminous coals usually available. The author then went on to point out that a defect in producer-gas plants is the loss of sensible heat by the gas on leaving the generator; and this had, he said, naturally led several engineers to utilize this heat by some system of regeneration. Various devices had been employed for the purpose; but the most successful had been that which converts the heat into the necessary steam for the gasification of the fuel—this system being also the most economical, as all the sensible heat available is required for such steam-raising purposes. Rather more than three years ago, the firm with which Mr. Rigby is connected experimented in this direction simultaneously with some of the gas-engine makers on the Continent, with the result that they put on the market an anthracite pressure plant. This and other plants he proceeded to describe in detail by the aid of diagrams.

The author then passed on to the subject of the utilization of the power gas produced on the regenerative system. He pointed out that one of the fields in which the gas-engine is likely to play an important part is in the generation of electricity, either for central station works or otherwise; and he stated that his firm had, during the past fifteen years, supplied a large number of

engines for this class of work, and had fitted up many stations with gas power for public supply, mainly on the Continent. The majority of them, however, were supplied by anthracite gas plants, with steam-boiler and gasholder. They worked well in most cases, but were not nearly so economical in running costs as were those worked according to modern practice; and he thought it was with the use of producer gas on the regenerative system he had described that great developments might be expected. Within the past few years, and notably within the last year, gas power had, he said, been supplied for a number of central stations of moderate power in England; these being driven by anthracite or coke gas plants on this system. The results of the tests of some of these were given in the appendices to the paper; and he considered that this development was likely to have a marked bearing on central station practice when using gas power. The working costs had been received of such a station, which had been in use for two years at Milford-on-Sea, in which the fuel costs were 0·334d. per unit generated with coal at 27s. per ton. The coal consumption when running averaged 1·54 lbs. per unit generated, while the consumption, including all stand-by losses, was 2·275 lbs. per unit. This small station, though only of 25 kilowatt maximum capacity, and having only a small load factor, was actually more economical from many points of view than most of the large steam central stations. Excellent as was this result, Mr. Rigby said it could be improved upon, as the suction-gas plant in question was the first of its type built; and with a similar station under present conditions with direct-coupled dynamos the coal consumption would be considerably under 2 lbs. per unit generated, including stand-by loss. With larger units, the net consumption would be lower still. The results of a test taken a few months after the installation had started to work showed that the consumption was lower than that under usual working conditions.

In another appendix were given the results of a test made at Openshaw, by Messrs. Crompton and Co., Limited, of a 55 kilowatt set—one of three supplied for the new Howrah station of the Calcutta Electric Supply Corporation, Limited. They were designed to operate with the ordinary gas coke obtainable in Calcutta, but were actually tested on Manchester gas coke, containing a small proportion of tar. It has been long known that gas coke is an ideal fuel for gas-producers, if the tar can be effectively removed from the gas; and in this plant the apparatus was arranged on what might be termed a semi-bituminous suction-gas system, and Mr. Rigby said it was very effective in cleaning the gas. Every precaution was taken to ensure accuracy during the test, and the dynamo had a very high efficiency. The final result—viz., 26·54 per cent. of the calorific value of the coal appearing as indicated work in the engine, 22·7 per cent. efficiency as actual work at the engine crank-shaft, and 20·8 per cent. as electrical energy at the dynamo terminals—was the highest thermal efficiency yet authoritatively recorded of work obtained from solid fuel to his knowledge. One feature of the trial was the regularity and uniformity of the gas produced; the mean pressure of the indicator cards varying only 5 per cent. above and 1·25 per cent. below the average throughout the trial.

The author went on to show that one of the great advantages of gas-producers for variable loads is that great fluctuations of demand for power are instantly responded to. After trials under various loads, a load of 10 brake horse power was put on the engine, and kept on for four hours. At the end of this period, the full load of 80 brake horse power was thrown on suddenly; and the set responded to it immediately, without any perceptible variation or flicker of the lights, and kept this load till the end of the run.

This was done without any extra plant whatever, and without the use of a gasholder. Another feature of gas-producers for such work is that the labour in coal feeding and stoking is not affected by such fluctuations; and in the Calcutta plants storage is provided for four hours' supply at full load. Gas-producers can be banked up, and a fire kept in them with little loss, for a fortnight if necessary; and they can be running under full load in from 10 to 20 minutes, according to the size of the units.

In another appendix was given the full-load test of a station at Dollar, N.B.; and the author said he had been informed by Mr. Scott-Moncrieff, the General Manager of the Electrical Supply Corporation, Limited, that their gas-power stations were proving very economical. At Dollar, the fuel consumption per unit generated is only 3·1 lbs., including stand-by, and 3·927 lbs. per unit sold, although it has an extremely low load-factor, and a stand-by plant equal to the maximum working capacity of the installation. The coal used is Scotch anthracite, costing 17s. 9d. per ton delivered, which brings the actual cost to 0·295d. per unit generated and 0·373d. per unit sold. Mr. Rigby remarked that this small central station, working perhaps under the most unfavourable circumstances, was more economical than most existing large steam stations. The gas-driven station at Walthamstow has a fuel cost of 0·46d. per unit sold; anthracite costing 26s. per ton delivered. Comparing this with the small station at Milford-on-Sea, with coal at 27s., the fuel costs, including all accumulator and distribution losses, are only 0·43d. per unit. A large station working with anthracite is at Guernsey, with fuel costing 18s. 6d. per ton delivered in the bunkers; and the average cost comes out at 0·243d. per unit generated, with a good load-factor. Another station of the Electric Supply Corporation is at Totnes, where the sets in use are each of 33 kilowatt maximum capacity. The fuel used in this station costs 25s. 9d. per ton delivered, and the load-factor is 19 per cent. The fuel cost per unit sold is 0·352d., which is lower than Milford, and, though fuel at the same price is used, much lower comparatively than Walthamstow, taking into account the stand-by rating and the size of the plant employed.

No central station exists in which common bituminous fuel is used; but Mr. Rigby said he could see no reason why such fuel should not be employed, as plants are now made from 80 brake horse power upwards to any size. Several installations have been made by his firm, in which the working conditions are quite as onerous as any in central station practice. In such a station the fuel cost would be, in most cases, reduced to quite one-third that quoted as being possible with anthracite fuel; and any extra capital expenditure required would be well compensated for by reduced running costs. In another appendix were given the results of a test taken of a small bituminous plant. They showed that, though the thermal efficiency is not so great as when using anthracite, the low cost of fuel more than compensates for this. Mr. Rigby stated that larger plants had been made, but they had not been so accurately tested as was this one; and the efficiency given was the highest authoritatively recorded to his knowledge with bituminous coal as fuel. Referring to the use of gas coke, the author pointed to the Howrah test as evidence that high economy could be obtained by using this fuel; and he said that in a great many cases it would undoubtedly be used, as it could be obtained very cheaply. He thought that for corporations and district councils controlling both the gas and electricity works, it constituted an ideal combination—the principal bye-product of the gas-works being converted into electricity; and instead of the two works being in competition, as was usually the case, they would be able to run more together, supplying the energy or light most suitable for their respective requirements.

The author next passed on to deal with the action of the gas in the motor, and pointed out that the tests and tables he had referred to had been based and taken with engines as made by his firm up to a short time ago; but he thought it would be of interest to mention certain matters which had occurred within the last few months, which seemed destined to forward the development of the internal combustion engine. He then referred to the suggestion by Mr. Dugald Clerk, in his "James Forrest Lecture" to the Institution of Civil Engineers last year, for overcoming the trouble of pre-ignition by making the actuating mixture less rich than usual by the "added air" system, and also to the experiments which were being conducted by his firm to achieve the same object in a simpler way—viz., by reducing the trouble through heated cylinders by admitting water spray into them during the suction stroke of the engines. Professor Burstall, of Birmingham, was invited to test one of the engines thus fitted, and the result was a distinct advance. Mr. Rigby expressed the opinion that its effect on the future of the gas-engine would be that the coal consumption shown in his tests could probably be decreased from 10 to 20 per cent. compared with the gas power previously in use. Since these tests were made, further economies have been obtained by judicious design; and a test made by Mr. J. Anderson early last month showed 32·27 per cent. as the actual thermal efficiency obtained compared with Professor Burstall's 30·8 per cent.—an increase of 1·47 per cent., obtained with a smaller engine.

Mr. Rigby concluded by remarking that new fields are being opened out every day in which the internal combustion engine is likely to play an important part; and in nearly every case this advance displaces steam power, which he thought had almost reached the limit of its possible economy, while the engine was only on the threshold of its career, with encouraging possibilities. He pointed out that Sir William White and other distinguished authorities had recently discussed the use of gas-engines for marine propulsion; and though it might appear to be a great departure, it would, in his opinion, be succcssfully applied sooner or later. A gas-producer plant to use either anthracite or bituminous coal could, he said, be designed without difficulty for sea-going purposes; and it would, if anything, work better at sea than on land. There seemed to be no obstacle to successful application except the design of the engine. Rapid strides were being made with the internal combustion engine; and the probability was that in the course of the next twenty years ocean liners successfully propelled by power gas would come into extensive use.

The following particulars in regard to some of the tests referred to by Mr. Rigby are taken from the appendices to the paper:—

Test of Special Engine, Coupled Direct to Dynamo, with Suction-Gas Plant Working with Ordinary Gas Coke.

The set tested was one of three for the Howrah station of the Calcutta Electric Supply Corporation, Limited. The coke was obtained from the Manchester Corporation Gas-Works, and the sample analyzed was certified by the Chief Chemist to have the following percentage composition: Ash, 15·6; moisture, 1·3; volatile matter, 1·8; fixed carbon, 81·3. Its calorific value was 12,411 B.T.U. per pound. To ensure complete accuracy with regard to the measuring of the fuel after the test run, the ashes and clinker were removed from the lower portion of the producer, and the fire was made good again to a predetermined level at which the start was commenced. The actual time of the full-load test was six hours; but the producer was working 20 minutes before this, to get the fire in good condition for starting, and the fuel so burnt was not deducted from the total consumption, so that the results

given below would have been slightly better if any arrangement had been made to measure the amount of such coke burnt before the commencement of the full-load test. One feature of the trial was the uniformity of the indicator diagrams, and the regularity of the quality of the gas, which showed on analysis the following percentage composition: CO_2, 7·8; O, 0·5; CO, 21; CH_4, 0·2; H, 15; N (by remainder), 55·5. The engine had an 18-inch cylinder with 24-inch stroke.

Duration of trial	6 hours
Average load on dynamo	61·4 kw.
,, brake horse power of engine	89·71
,, indicated horse power ,,	104·83
Maximum mean pressure of indicator diagrams	85·40 lbs.
Minimum ,, ,, ,, ,,	80·3 ,,
Average ,, ,, ,, ,,	81·35 ,,
,, number of explosions	83·55
,, ,, of revolutions per minute	200·20
Total fuel consumed	488 lbs.
Fuel per hour	81·330 lbs.
,, kilowatt hour	1·325 ,,
,, indicated horse-power-hour	0·779 lb.
,, brake ,, ,, ,,	0·910 ,,
Mechanical efficiency of engine	85·57 per cent.
Thermal efficiencies—	
Electric energy at terminals ÷ B.T.U. in fuel	20·80 ,,
Brake horse power energy ÷ B.T.U. in fuel	22·71 ,,
Energy indicated on engine ÷ B.T.U. in fuel	26·54 ,,
Heat efficiency of producer plant, calculated from the known efficiency of the gas-engine	89·50 ,,

Test of Gas-Engine, Rope-Driven Dynamo, and Suction Plant at the Milford-on-Sea Electricity Works.

The engine was one of Crossley's, with 11½-inch cylinder and 24-inch stroke, the fly-wheel being grooved for 4-inch ropes, which drove a Siemens shunt-wound dynamo of 25 kilowatt capacity at 700 revolutions per minute. The suction plant was the first of the size made by Messrs. Crossley; and the installation had been at work some months at the time of the test. This was commenced with a flying start; the producer being at the same time filled with coal to a predetermined level. The coal used was anthracite, about 1 inch cube; and a sample was tested at the National Physical Laboratory—the calorific power being certified at 14,895 B.T.U. per pound.

Duration of test	3 h. 49 m.
Average load on dynamo	23·62 kw.
Average revolutions of engine per minute	232
,, number of explosions ,,	113
,, mean pressure of indicator diagrams	65 lbs.
,, indicated horse power of gas-engine	46·25
Total coal used during trial	133·50 lbs.
Average per hour	34·95 ,,
Coal per kilowatt-hour	1·48 ,,
,, indicated horse power hour	0·755 lb.
Assuming mechanical efficiency of engine to be 85 p. ct. as is usual, the brake horse power of engine was	39·31
Coal per brake-horse-power-hour	0·89 lb.
Efficiency of dynamo and rope drive	80·4 p. ct.
Thermal efficiency of fuel conversion	22·8 ,,

Test of Gas-Engine, Belt-Driven Dynamo, and Suction-Gas Plant at Dollar.

In this test Scotch anthracite was used having the following percentage composition: Ash, 4; moisture, 2·4; volatile matter, 6; fixed carbon, 87·6. Its calorific value was 15,138 B.T.U. per pound. The producer was completely filled to a predetermined level, when the actual full-load test was commenced; and at the end of the test the fire was clinkered and the ashes removed before measuring the final weight of fuel to make up the predetermined level in the producer. The engine had a 10-inch cylinder with 21-inch stroke; and the governing was on the "hit and miss" principle.

Duration of test	7 h. 30 m.
Total coal consumed	163 lbs.
Average coal consumed per hour	21·733 lbs.
,, load on dynamo	16·803 kw.
,, mean pressure of indicator diagrams	70·5 lbs.
,, indicated horse power	32·06
Assuming 85 p. ct. mechanical efficiency, the brake horse power was	27·25
Coal per kilowatt-hour	1·293 lbs.
,, brake horse power	0·797 lb.
,, indicated ,,	0·677 ,,
Thermal efficiencies—	
Indicated work ÷ B.T.U. in coal	24·95 p.c.
Assumed actual horse power ÷ B.T.U. in coal	21·26 ,,
Electrical energy ÷ B.T.U. in coal	17·60 ,,
Average revolutions per minute	229·6
,, explosions ,,	109·0
Efficiency of dynamo and belt drive, about	82·6 p.c.

Test of Bituminous Type Gas Plant and Two Gas-Engines.

The plant was designed to give 124 brake horse power working load, and was of 150 brake horse power maximum capacity. A guarantee had been given that the consumption of common Derbyshire slack coal should not exceed 1½ lbs. per indicated horse-power-hour, either working at 150, or with any intermediate load down to 50 indicated horse power—this consumption to include all fuel used for auxiliary steam raising in the boiler. The calorific value of the fuel was 12,110 B.T.U. per pound. Each engine had a 16-inch cylinder with 21-inch stroke. The first test was taken with the two engines at work, and was continued for six hours; but as the guaranteed coal consumption seemed to be easily obtained, it was decided to proceed with the more crucial test—viz., with one engine only at work, approximating one-third load. This test was of 24 hours' duration. At the end of the runs the producer was poked, and the table rotated to ensure a clear fire before the fuel necessary to fill the producer to the level was weighed in at the end of the test.

	First Test.	Second Test. No. 1 Engine.
Duration of test	6 hours.	24 hours.
Fuel consumed in producer	440 lbs.	1012 lbs.
,, ,, steam-boiler	88 ,,	130 ,,
Total weight of fuel	528 ,,	1142 ,,
Average per hour	88 ,,	47·58 ,,
Maximum pressure on diagram	101 ,,	103·00 ,,
Minimum ,, ,,	97 ,,	95·00 ,,
Average ,, ,,	98 ,,	97·30 ,,
Average explosions per minute—		
No. 1 engine	41·47	46·65
No. 2 engine	52·18	—
Average indicated horse power—		
No. 1 engine	43·34	48·4
No. 2 engine	54·53	—
Total average indicated horse power	97·87	—
Deducting power required for driving gas-plant machinery left a total of	90·87	42·4
Coal per indicated horse power in terms of the guarantee	0·968 lbs.	1·122 lbs.
Thermal efficiency	21·88 p. ct.	18·87 p. ct.
Average revolutions per minute	—	160·5

Professor Burstall's Test of a New Type of Gas-Engine.

As stated in the paper, Professor Burstall, of Birmingham, was invited by Messrs. Crossley to test a gas-engine in which they had endeavoured to improve the efficiency by increasing the compression. In the course of his report, Professor Burstall said: "Up to the present, when using coal or producer gas, the compression has been limited to about 110 lbs. per square inch. Compressions higher than this are apt to heat up the charge to such an extent as to cause premature ignition—that is, the charge ignites before the end of the compression stroke. Messrs. Crossley have recently [November, 1904] brought out a new type of engine, in which the compression is carried to over 200 lbs. per square inch and in which premature ignition is prevented by drawing in a small quantity of water during the suction stroke. The engine tested was of the electric lighting type, with an extra heavy fly-wheel and an outer bearing, which, to some extent, accounts for the mechanical efficiency being lower than in their ordinary type of engine. The engine cylinder was 14 inches diameter with 21-inch stroke; and the duration of the test lasted for 6 h. 45 min. During this time the engine ran perfectly smoothly, without either premature ignitions or back explosions. The calorific value of the gas was determined at intervals in a Junkers calorimeter, the average value being 578 B.T.U. per cubic foot at a temperature of 60° Fahr., and under a barometric pressure of 30 inches. The clearance volume was 0·243 cubic foot; the cylinder volume being 1·872 cubic feet, and the ratio of expansion 8·7. The maximum pressure in the cylinder was 528 lbs. above atmospheric pressure; the volume at maximum temperature being 0·247 cubic foot. The average pressure during suction was 1·9 per square inches below that of the atmosphere—that is, 12·8 lbs. per square inch absolute. The compression curve equals 6508 foot-pounds, and the expansion curve 17,610 foot-pounds. During the suction stroke, the injected water appears to be turned into steam, which becomes superheated during compression. Heat passes into the charge from the walls until a pressure of about 160 lbs. per square inch is reached, when the charge appears to be as hot as the walls. The heat additions prove that the whole of the available heat—that is, the total heat of the charge, less that rejected into the water-jacket, has appeared at the point of maximum temperature. Taking the total heat of the gas used per explosion as 100, the indicated work is 37·4; the heat rejected into the water-jacket is 29, and that into the exhaust 33·6. The percentage of useful work is the highest thermal efficiency which has to my knowledge been obtained in a test." The gas used in the trial was that supplied by the Manchester Corporation, a sample of which, taken at Messrs. Crossley's works at Openshaw, was analyzed by Professor Percy F. Frankland, F.R.S., and was found to have the following composition:—

	Percentage by Volume.
Carbon dioxide	2·14
Heavy hydrocarbons	6 80*
Hydrogen	42·90
Carbon monoxide	14·99
Marsh gas	30·93
Nitrogen	2·24
	100·00

* Equivalent to 8·5 per cent. of ethylene (C_2H_4).

Professor Frankland found that 100 volumes of the gas consumed 117·81 volumes of oxygen; and that its heating value (by calculation) was 582 B.T.U. per cubic foot.

The World's Production of Petroleum.—A number of interesting statistics are given in a recent issue of the "Petroleum Review," showing the production of petroleum throughout the world during the past year. The quantity is placed at 28,577,900 tons, and it constitutes a record in petroleum production, being more than 3,000,000 tons in excess of the bulk produced during the previous year. The production of the various important fields was as follows: America, 15,000,000 tons; Russia, 10,600,000 tons; Sumatra, Java, and Borneo, 1,000,000 tons; Galicia, 827,100 tons; Roumania, 496,800 tons; India, 404,000 tons; other countries, 250,000 tons. Very substantial increases are noted in all the different centres, and the figures prove unmistakably that, however rapidly the uses of oil extend, there can be little fear of any shortage of supply, for at the present time many fields are only crippled in their output by lack of storage facilities and methods of transportation.

FIRE-CLAY AND DINAS MATERIAL FOR RETORT-SETTINGS.

By Dr. F. Leisse, Chemist to the Cologne Gas-Works.

Abstract Translation of a Paper read before the Association of Gas Engineers of the Rhenish Provinces and Westphalia.

[From the "Journal fur Gasbeleuchtung."]

Higher makes, greater capacity of retorts, and longer life of the settings are factors which the gas manager keeps before him in the working of the retort-house. The transition which comparatively recently has been witnessed from direct-fired to semi-producer furnaces, and ultimately to producer furnaces, has directed inventive talent to this field of industrial heating. The results attained with settings of inclined retorts, and even with vertical retorts and carbonizing chambers, show that the same end may be practically achieved in several ways. But the changes in settings make greater demands on the refractory materials of which they are constructed; while the raw material from which they are produced remains the same.

The special refractory brick used hitherto in retort-settings is fire-brick of which the basis is refractory clay, both burnt and unburnt. In its pure state, clay is a silicate of alumina having the composition shown by the formula: $Al_2O_3 + 2SiO_2 + 2H_2O$. It thus contains about 46 per cent. of alumina, and is the most refractory of all the basic materials applied in practical furnace construction. But its occurrence is restricted to a few places; and the maker of fire-resisting products has to deal with a raw material more or less contaminated with foreign substances, such as iron, alkalies, lime, magnesia, and sulphur. These constituents greatly affect the fire-resisting powers of the fire-clay; and hence the quality of fire-bricks, &c., varies within wide limits. Further, the quality of the bricks is also affected by the physical condition of the material, or the mode and degree of granulation, the proportions mixed, and the temperature of burning. Thus it comes about that the greater number of users have to depend solely on the repute of the various makes of fire-bricks.

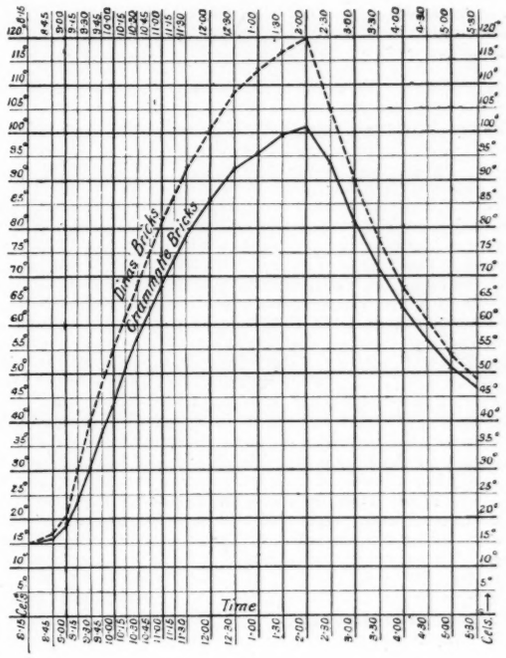
How comes it about that the maker of fire-bricks has not improved them to meet the demands of the gas engineer in respect of durability, and that the fluxing of settings and premature deformation of retorts are still met with? Apart from the frequent case of improper manipulation of the setting, the principal reason of such behaviour lies in the chemical and physical properties of the fire-clay material itself. The making of fire-bricks usually consists in mixing intimately one part of raw clay with two to three parts of burnt clay (fire-brick), and burning the moulded and dried brick for about fourteen days at a temperature of about 2370° Fahr. The brick thereby loses from 5 to 7 per cent. in volume, which reduction is due to the clay giving up its chemically combined water and organic constituents, and the individual particles of clay coming closer together.

A good brick, in addition to refractoriness, must be impervious and strong; and these requirements are primarily dependent on its suffering no shrinkage in use. Shrinkage of the constructing material is fatal to the stability of a setting. Unfortunately, it is impossible with fire-clay bricks wholly to avoid further shrinkage after burning, because the temperature of the producer or regenerative setting, locally, at least, frequently exceeds that at which the bricks were burnt, and even more, because the continuously high temperature causes contraction to continue. The evils experienced were commonly attributed to the fire-clay used in binding the bricks together, and gradually bricks were displaced frequently by large blocks, with the object of overcoming or reducing the difficulty previously found. But the desired result was not attained. A thorough burning of the bricks or blocks became more and more difficult of accomplishment as their size was increased, and special shaping was required; and they suffered correspondingly more in use. Recently the tendency has been to revert to the simple brick.

Another undesirable feature of the fire-clay brick is that it softens at a high temperature as well as shrinking. The reason for the softening is not wholly established; but it is known that the lower layers suffer from the pressure of the upper, and the iron, alkalies, and sulphuric acid contained in the dust and vapours from the fuel react with the softening brick, and provoke fluxing. Thus passages and gas-inlets in the setting become closed up, as is well known. Analyses of various runs and fluxed portions showed upwards of 30 per cent. of iron; while the flue ash contained upwards of 47 per cent. of iron and 33 per cent. of sulphuric acid. In order to study the shrinking and softening of fire-clay bricks, several well burnt and good bricks from different makers were exposed for fourteen days to a temperature of upwards of 3100° Fahr.; and it was observed that in the greater number of cases there was either only a shrinking in the direction of imposition, or that this shrinking exceeded the general shrinking. This necessarily was dependent on the softening of the brick and the pressure of the overlying parts.

In order to secure the highest possible proportion of alumina in the fire-bricks, makers have recourse to adding some enriching material to the fire-clay. Thus works on the Rhine add to the clay the rare North Bohemian slate clays found in Rakonitz and Neurode, which contain upwards of 45 per cent. of alumina. But these rich clays tend to cause shrinking of the products; and bricks made with an addition of them shrink greatly, and cannot be burnt dead in manufacture. It should be understood that a guarantee of 50 per cent. of alumina in fire-bricks, which is sometimes offered, is no surety of their good quality. An artificial inflation of the proportion of alumina is of no advantage in itself, as in that case everything depends on the pyrometric behaviour of the enriching material. Bauxite, which contains upwards of 80 per cent. of alumina, is commonly used; but besides some iron it contains also up to 4 per cent. of titanic acid, which is likewise a dangerous flux. So the use of bauxite has ceased in the majority of fire-brick factories.

The shrinking and softening which are inherently characteristic of bricks made of fire-clay, clearly preclude them from being regarded as ideal for the construction of retort-settings. Another class of refractory material has therefore been tried—viz., silica. Siliceous bricks have long been used in steel and glass furnaces; and they have been employed in gas-works in many cases in conjunction with fire-clay bricks. The typical siliceous brick—known as Dinas from the name of the place where the raw material is found in England—consists chiefly of silica, with small quantities of alumina and iron, and about 2 per cent. of lime as binding material. A good English Dinas contains 95 per cent. of silica, 2 to 3 per cent. of alumina and iron, and 1 to 2 per cent. of lime. Such a Dinas brick is highly refractory, usually surpassing a good fire-clay brick in this respect. Its distinguishing characteristic, however, is that it increases instead of diminishing in volume under the influence of high temperatures. This increase in volume is mainly due to an increase in the actual substance of the brick, owing to its transition from the crystalline to the amorphous condition. The mode and duration of the increase vary within very wide limits with Dinas bricks; and hence it is of the first importance in the manufacture to select the raw material with care.



Sample bricks from various sources tried at Cologne were found on exposure for fourteen days to a temperature of upwards of 3100° Fahr., to have undergone a linear expansion of from 0·9 to to 3·4 per cent. The question of how far this and the other properties of Dinas bricks affect the stability of a setting constructed of them could only be answered by practical trial, in which all the external and internal influences would play their part.

A trial in 1902-3 of a setting of seven retorts, built of Dinas bricks, was so far favourable that further trials were decided upon. The initial expansion of the material caused cracks to appear in the retorts during the first few days; but they were not of a very dangerous character, and remain unchanged after prolonged working of the setting. No settling took place, even when the retorts had been let down and restarted many times; while similarly constructed and worked fire-clay brick settings soon showed this fault. In the following year, ten beds of seven and two of nine retorts were accordingly built with Dinas bricks, and were subjected to an extremely hard four months working, at the end of which they were let down in perfectly good condition ready for use in the following winter. It was found that the Dinas material was not injuriously affected by some unusually violent fluctuations of temperature to which these sittings happened to be exposed.

Thus it was clear that the most suspicious qualities of the Dinas bricks—viz., expansion and sensitiveness to changes of temperature—presented no obstacle to their employment; and when the

settings were let down, it was further found that they showed various distinctly favourable characteristics. The premature deformation of the retorts which results from the nature of fire-clay was prevented as far as possible with it by putting stronger and more numerous supporting walls, with the consequence that large combustion chambers, which favour good utilization of the heat, were sacrificed. The dissociation of carbonic acid and steam, which begins above 2200° Fahr., is promoted by small combustion spaces, whereas large combustion spaces, which encourage the free development of the flame, result in high temperatures. The Dinas bricks admit of a reduction of the supporting walls, and thus afford larger combustion spaces; so that there is a longer sojourn of the gases in the furnace owing to the reduced draught.

The action of the blown dust, and the chemical attacks, which are so destructive when the fire-clay begins to soften, do not affect Dinas material, notwithstanding that the more porous nature of the latter would seem to expose it more freely to chemical influences. Settings of Dinas bricks show none of the fluxing which occurs with fire-clay; and as there is no change to the liquid or semi-liquid condition, chemical reactions are not so likely to occur as with the softened fire-clay bricks. Even at the highest temperatures, Dinas bricks retain their granular structure; and this is the best security for the prolonged life of the setting. It was further observed that when settings were being brought into action, there were, with fire-clay, dull zones corresponding with the positions of the supporting walls, which disappeared only when the heats were fully up; whereas with Dinas settings zones of different heats could never be detected. On the other hand, the Dinas settings appeared soon to assume a full heat, which was more powerful than that of fire-clay settings. This would be in accordance with the better conductivity of the Dinas material, and in opposition to the accepted view that fire-clay is the better conductor of heat. The granular structure characteristic of Dinas brick would also point to its being a bad conductor. It therefore seemed of importance to ascertain experimentally which material was the better conductor of heat. After numerous experiments and changes of the conditions of testing, results were obtained which indubitably established the superior conductivity of the Dinas material. These results have been plotted out in the curves given in the diagram.

The test brick was placed on edge, embedded in a sand bath, and with its upper half protected by asbestos. Three thermometers dipped into it to different depths; and the average of the three readings gave the results from which the curves have been drawn. The divergence of the curves clearly indicates the difference in the conductivity of the materials. The better conductor a material is, the more energetically it gives up heat to its environment when the source of heat is withdrawn. The diagram illustrates the superiority of Dinas to fire-clay in this respect, by the more rapid fall in temperature which it showed when the burner was turned out and the insulating material removed. A great number of tests showed that, on the average, the Dinas material had 20 per cent. better conductivity than fire-clay rich in alumina and of fine grain. The assumptions favourable to Dinas can only be substantiated by actual practical trials. As a fact, the trial Dinas setting of seven retorts at Cologne had a greater productive capacity than would have been assumed for fire-clay.

In order to determine whether the higher temperature which the foregoing considerations would lead one to expect would prevail in Dinas as compared with fire-clay settings, some pyrometric observations were made on five Dinas settings and five adjacent settings constructed of Dinas and fire-clay in alternate layers. The average temperature at a particular spot in the retort chamber was 1100° C. with the Dinas, and 1110° C. with the other settings; but the retorts in the first showed 1135° C., and in the second only 1074° C., or a difference of 70° C., or (say) 128° Fahr., in favour of the Dinas settings.

SULPHUR IN COAL GAS.

By Dr. Ad. Samtleben, of Bernburg-in-Anhalt.

[Abstract Translation from the "Journal für Gasbeleuchtung."]

Both the amount of sulphur in the finished gas and the amount of sulphuretted hydrogen in the crude gas are observed by frequent analyses in gas-works where the manufacture is subject to the constant control of a chemist. But on small and medium-sized works, such control is lacking; and generally the sulphur question is disregarded. The now common practice of revivifying oxide of iron *in situ*, and the absence in Germany of restrictions on the amount of sulphur in the gas which is not absorbable by oxide, make it feasible to carbonize coals containing a lot of sulphur. Nevertheless, the large German gas-works which use highly sulphurous coal aim at keeping the sulphur in the finished gas below a certain limit, say, of 26 to 30½ grains per 100 cubic feet. The author in the past year has had occasion to give attention to the amount of sulphur in the Bernburg gas, and proposes to deal with his investigations in this communication.

The Bernburg Gas-Works are in the position of being able to use coal from either Westphalia, Silesia, or Saxony, as well as English coal. A Yorkshire coal, mixed in equal proportions with a Westphalian, was carbonized with advantage in the previous year. But the gas appeared to contain a lot of sulphur, judging by the rapidity with which the purifying material was used up. Moreover, the copper gas-fittings, especially the smoke protectors, showed signs of corrosion, and a greyish green efflorescence of basic copper sulphate appeared on them. In one place where a large gas-cooker was used without a flue, complaints were made of a so-called choking smell. There was no sulphuretted hydrogen in the gas as distributed; so it was decided to make determinations of the amount of sulphur present as carbon bisulphide and organic sulphur compounds, and at the same time to ascertain how much sulphuretted hydrogen was removed in the purifiers.

During the period from Jan. 16 to Feb. 4, 1904, fourteen determinations of sulphur in the purified gas and eight of sulphuretted hydrogen in the unpurified gas were made. Throughout this time, the coal carbonized was half Yorkshire and half Westphalian. The amount of sulphur in the purified gas averaged 40·6 grains per 100 cubic feet; the maximum being 46·3 grains and the minimum 33·5. The amount of sulphur in the form of sulphuretted hydrogen in the unpurified gas averaged 0·89 volume per cent.; the maximum for a day being 1·05 and the minimum 0·75 per cent. This quantity, although high, was not so high as was to be expected from the frequency with which the oxide had to be changed.

These results led to the endeavour to obtain gas less rich in sulphur by working with other coal. It was assumed, from statements in gas literature, that the high figures found were due to the Yorkshire coal; and Durham coal was accordingly tried. At first, it was mixed, like the Yorkshire coal, with equal quantities of Westphalian, and this mixture was carbonized from May 29 to June 2. The average amount of sulphur found in the purified gas was 41·5 grains per 100 cubic feet; the maximum being 44·4 grains, and the minimum 38·8 grains. The results were therefore nearly the same as with the Yorkshire—as indeed was not unlikely, seeing that the total sulphur in the coal amounted to 1·43 per cent. for the Yorkshire, and 1·47 per cent. for the Durham. The temperatures of the settings and the times of working off were the same in the two cases.

Next, Durham coal was carbonized for a time by itself, under similar conditions, with a view to ascertaining what share the English coal had in the production of the sulphur compounds found in the gas. It was used alone from Aug. 5 to 9. The average amount of sulphur found in the purified gas was 42 grains per 100 cubic feet; the maximum being 42·8 grains, and the minimum 41·7 grains. The amount of sulphur in the form of sulphuretted hydrogen in the unpurified gas averaged 0·86 per cent. by volume; the maximum for one day being 0·87, and the minimum 0·83 per cent. The results differed little from those previously obtained, and were therefore surprising, because the English coal had been regarded as the chief source of the sulphur previously found, and the Westphalian coal as contributing but little towards it. In order to get more light on the matter, Westphalian coal was carbonized by itself from Aug. 12 to 16. The average amount of sulphur found in the purified gas was 36·2 grains per 100 cubic feet; the maximum being 36·8 grains, and the minimum 34·2 grains. The amount of sulphur in the form of sulphuretted hydrogen in the unpurified gas averaged 0·79 per cent. by volume; the maximum for one day being 0·82 per cent., and the minimum 0·74 per cent.

It was thus ascertained that the Westphalian coal yielded nearly as much sulphur to the gas as the English coal. The Westphalian coal, as used, was a mixture, in equal proportions, of supplies from two pits; and the sulphur in these coals amounted to 1·07 and 1·87 per cent. respectively, or an average of 1·47 per cent., which is substantially the same as with the English coals used. Assuming that the sulphur is similarly combined in these different coals, it might be expected that the gas from all of them would contain nearly the same proportion of sulphur compounds, as was indeed found to be the case. The coals were carbonized under similar conditions in all the trials. The results indicate that, in order to keep down the amount of sulphur in the distributed gas, and to relieve the purifiers, the German coal must be carefully selected if English coal containing much sulphur is used in conjunction with it. The Westphalian coal varies greatly in the amount of sulphur it contains, and some kinds of Silesian coal also contain much sulphur.

In order to obtain further information on the matter, a coal from Upper Silesia was carbonized by itself from July 15 to 30. It contained, on the average, 0·9 per cent. of sulphur. The proportion of sulphuretted hydrogen in the unpurified gas averaged 0·45 per cent. by volume; the maximum on any one day being 0·6 per cent., and the minimum 0·35 per cent. The amount of sulphur in the purified gas averaged 11·35 grains per 100 cubic feet; the maximum being 11·9 grains, and the minimum 10·1 grains. A coal from Saxony, containing 1·05 per cent. of sulphur, gave somewhat less favourable results. The average proportion of sulphuretted hydrogen in the unpurified gas during a five days' trial of this coal was 0·73 per cent. by volume; and the sulphur in the purified gas averaged 25·2 grains per 100 cubic feet. The Upper Silesian coal was therefore to be preferred for mixing with English coal. The purifiers needed recharging about twice as often when Westphalian and Durham coal were used as when this Upper Silesian coal was carbonized.

With the smaller gas-works, the necessity for more frequent charging of the purifiers may be disregarded, provided a coal

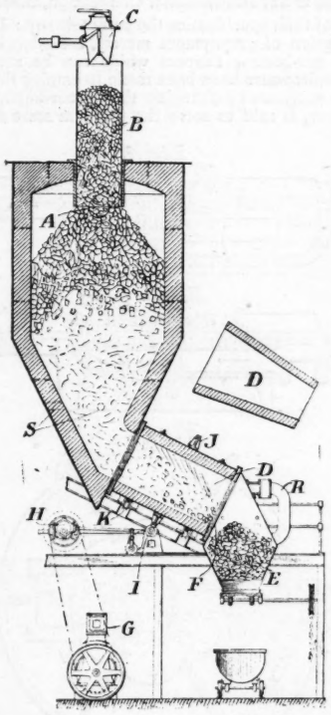
satisfactory in respect of quality of gas and coke is to be had at a low price; but it is otherwise with the sulphur in the purified gas. Pettenkofer, indeed, has expressed the opinion that gas containing whether 9 or 30 grains of sulphur per 100 cubic feet is not objectionable on hygienic grounds, and even 43½ grains would be scarcely injurious. Bunte, however, has pointed out that the products of combustion of gas containing much sulphur attack the metal parts of gas-fires and lighting-fittings. The gas industry is under obligation to produce as pure a product as possible; and while washing or other processes for the removal of a quantity of as much as 43½ grains of sulphur per 100 cubic feet (which is equal to only 0·035 per cent. of carbon bisulphide by volume) appear out of the question for the time being, there remains the plan of so selecting coal that the sulphur in the purified gas is as little as possible. Exhaustive working trials, however, are necessary if this plan is adopted, because erroneous conclusions may be drawn if the amount of sulphur in the coal is taken as the sole guide. On this account, the consummation of the scheme for an experimental gas-works, projected by the German Association of Gas and Water Engineers, is earnestly to be desired, especially in the interests of the smaller gas-works, which cannot make comprehensive trials of different coals for themselves.

REGISTER OF PATENTS.

Generators for the Manufacture of Gas.—Radcliffe, J., of Elland. No. 7592; March 30, 1904.

This invention relates to means for producing gas from combustible materials. In former inventions the combustible material has usually been fed into the upper end of an inclined revolving chamber through which it descended slowly as the chamber was turned, exposing fresh surfaces for combustion, and combustible material has been purposely supplied to the revolving chamber. But, according to the present invention, the combustion takes place in a fixed chamber, and a revolving chamber is employed chiefly as a receptacle for the hot ash and as a means for heating the blast as it passes over the ash and for conveying the ashes away from the chamber in which the combustion takes place.

The generating chamber is provided with a gas outlet A, of such a capacity as to contain sufficient depth of fuel to convert the greater part of the oxygen admitted to it into carbon monoxide. Fuel is supplied at the upper end through a tube or fuel reservoir B, open at the lower end, and provided at the upper end with a hopper C, the



mouth of which is closed by a bell. Where a continuous feed is not desirable, the reservoir B is dispensed with, and a bell and hopper or sliding door is applied at the top of the generator and intermittently operated to allow of the fuel being delivered directly to it.

A rotating tube or chamber D communicates at its lower end with an ash-bin E; the passage of the ashes from the rotary chamber into the bin being retarded by the baffle-plate or ash bridge F. This baffle-plate, however, would not be required where the lower portion of the chamber D was curved, frusto-conical, or of extended length. An engine G actuates, by the eccentric H, ratchet wheel, and carrier wheel, the worm I, which engages the worm wheel J mounted upon the cylinder D. Anti-friction wheels K engage rings which support the cylinder while rotating.

The pipe R delivers air or air and steam at the top of the ash-bin, whence it passes over the hot ashes in the cylinder D to the fuel in the generator. If desired, a small quantity of air and steam may be delivered by the pipe R, and a larger amount directly to the generating chamber at S. Water jets may be employed to cool the ashes in the bin.

The ashes in the chamber D, when at rest, must be inclined at an angle of about 42°, which is the "natural slope" of the material being dealt with, as otherwise they would be discharged into the ash-bin with such rapidity that the whole of the fuel in the generator would follow and it would be impossible for any fuel to be retained therein. At the same time, it is advisable that the axis of the chamber D should be inclined as much as possible, in order to facilitate the passage of the materials through the apparatus; and therefore when it is of cylindrical form, the ash bridge F is necessary for maintaining the slope of the ashes unless the cylinder be of extended length. It is, however, sometimes preferable to dispense with the ash bridge, in order to allow the discharge of ashes in a thin layer at the lower end of the chamber; and this is accomplished by the adoption of a curved or frusto-conical shape of the lower end of the chamber, whereby the inclination of the working portion of the upper part of the chamber at any moment is greater than that of the working portion of the outlet end. The chamber may, however, be entirely frustro-conical in shape, as shown in the separate detail.

When starting to use the generator, the rotary chamber is charged with non-combustible material so as to prevent the raw fuel from entering it. The generating chamber is then charged, after a fire has been made and the blast started. In due course, the fuel becomes incandescent, resulting in the production of combustible gas as the air and steam pass through it. The rotary chamber is then revolved, permitting the hot ash to pass down and be discharged at the lower end; and the blast becomes heated as it passes over the hot ashes.

Rotary Gas-Meters.—Thorp, T., of Whitefield, near Manchester. No. 9602; April 27, 1904.

This invention consists in improvements on patent No. 20,214 of 1901, which are applicable to meters passing large volumes of gas comparatively to their size, with the object "to simplify the construction and reduce the cost of manufacture."

In the inferential or turbine gas-meter described in the earlier patent, an inner chamber having a free lifting inlet valve at the bottom, auxiliary jets acting on the outer part of the wheel vanes, and baffle-plates inside the chamber, are made use of in order to obtain accurate measurement of the gas passing through, when such volume is small compared with the capacity of the meter. In cases where the volume is very large comparatively to its size—in other words, where the current of gas has a high velocity, and where accurate registration is only required for quantities exceeding a minimum percentage of the maximum capacity of the meter—the patentee says he has found out by experiment that these parts may be dispensed with, provided the flow of the gas through the chamber on to the wheel vanes is perfectly uniform over their entire area. For instance, where the production of gas does not at any time fall below (say) 10 per cent. of the maximum production, and such gas is passed through a meter of comparatively small size or at a high velocity, a turbine meter made without inlet valve, auxiliary jets, or baffles inside the chamber will give accurate registrations of the production of the gas if the flow is equally distributed over the area of the turbine wheel. For the purpose of obtaining this uniform flow, the inner chamber is made with an open bottom, and a perforated plate (or more than one) of cylindrical, conical, or other form, is interposed between the bottom of the chamber and the outer casing of the meter.

On the illustration some of the arrangements suggested are shown—the two figures being vertical sections through the meter casing, each

Fig 1.

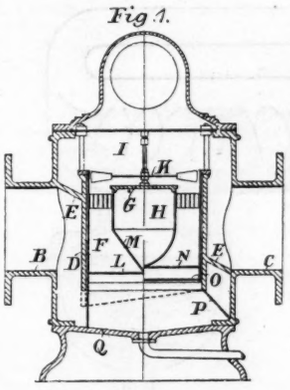
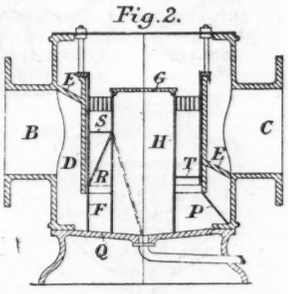


Fig.2.



showing a different arrangement of the perforated plates on either side of the centre-line.

The casing is arranged, as described in the 1901 patent, with an inlet branch B and an outlet branch C, a cylinder D in the centre, and a partition plate E surrounding it, and dividing the inlet from the outlet so that the gas has to pass through the cylinder. Into this, the cylindrical chamber F—fitted with guide-vanes, surrounding a central disc G and chamber H which support the fan-wheel K—is inserted, and attached to the plate I, above which the registering apparatus driven by the fan-spindle is arranged. The chamber F, however, is not formed with a bottom and a free lift-valve and auxiliary jets as described in the earlier specification.

Instead of them, in the arrangement shown by the left half of fig. 1 the cylinder F is prolonged beyond the bottom of the cylinder D

and perforated with fine holes in the projecting part; another perforated plate L being arranged horizontally at the apex of the cone M in which the chamber H terminates. In the arrangement shown by the right half of fig. 1, the chamber H is formed with an elliptical or hyperbolical bottom; and two perforated plates N O are arranged. Besides these, a perforated frustrated cone P is arranged between the bottom end of the cylinder D and the bottom Q of the casing.

In the modification shown by the left half of fig. 2, the cylinder F is prolonged and perforated as in the corresponding half of fig. 1. Between the wall of this cylinder and that of the chamber H, a frustrated perforated cone R and, level with the top of it, an annular perforated plate S are fitted. The wall of the chamber H may be extended to the bottom Q of the casing or stop short at the level of the annular plate S, or may be formed conical as indicated by the dotted line. In the modification represented by the right half of fig. 2, a frustrated perforated cone is arranged as in the corresponding half of fig. 1; the wall of the chamber H is extended to the bottom Q of the casing (or below the edge of the cylinder D); and a perforated plate T is arranged in the annular space between the cylinders H and F.

As mentioned before, in order to obtain a uniform upward current of gas over the entire area of the guide vanes, the perforations may be smaller or less numerous or both on the side of the gas-inlet B, for the purpose of obtaining a uniform upward current of gas over the entire area of the guide vanes, or the wall of the cylinder D may be carried lower down on this side than on the opposite side, as indicated by dotted lines in fig. 1.

Meter Indices.—Henderson, J. H., and Higgin, C. N., of Manchester. No. 10,836; May 11, 1904.

This invention is designed to facilitate the reading by the consumer of the quantity of gas that may have passed through the meter as indicated by the index dials; and it consists essentially in constructing the index so that the numerals can be read through apertures or slots in an enclosed case, in sequence—hundreds, thousands, tens of thousands, and so on—by means of leaping or jumping dials, which are caused at intervals to move forward the distance of one numeral instantaneously by cam-operated spring levers, spring pawls, or spring flirts, which are slowly moved backward by cams rotated by the train of counting wheels and forward by springs to actuate the levers.

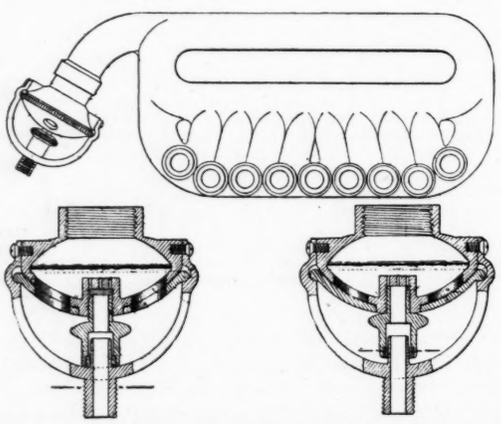
Charging-Machine for Gas-Retorts.—West, J., of Manchester. No. 11,849; May 24, 1904.

This apparatus is fully described and illustrated on p. 304 of to-day's issue of the "JOURNAL."

Gas-Burners for Heating and Lighting.—Clayton, R., and Whitehouse, E., of Deepfields, near Bilston. No. 13,108; June 10, 1904.

This invention has relation, in the one part, to regulators or devices for varying the proportions of gas and atmospheric air in the combustible mixture to compensate for variations in the quality, character, or pressure of the gas supply, and in another part, to the mounting and arrangement of certain kinds of gas-stove and gas-fire burners whereby the fitting of such burners is simplified, while the whole of the connections may be readily brought to the side of the fire-place so as to be easily accessible.

In view of the fact that with the ordinary coal gas there is often mixed a certain percentage of water gas, but the relative proportions are not always constant, it is proposed by the patentees to provide a double regulator or adjustable device whereby both the quantity of gas and the quantity of air admitted into the mixing-chamber of an atmospheric burner may be independently varied for the purpose of obtaining a constant heating effect under varying conditions of gas supply.



As applied to a regulator attachment for gas-fire burners, the side or bottom walls of the mixing-chamber, or an attachment secured to the mixing-chamber, is connected with the burner as shown, and perforated or formed with a series of air inlet holes; while the interior of the attachment is fitted with a rotatable baffle, which is also perforated or pierced, and suitable means are provided for operating the baffle from the outside of the attachment.

The engraving shows one form of the double regulating attachment applied to a gas-fire burner; also a transverse vertical section of the attachment separately. The whole of the gas-inlets and the adjustable air-inlets are fully opened in the left-hand section, so as to admit the maximum of gas and the maximum of air into the burner. The similar view shows the whole of the air-inlets and certain of the gas-inlets fully closed by the adjustable parts of the appliance. Thus, the patentees remark, provision is made for obtaining a combustible mixture of gas and air in any suitable proportions according to the character of the gas—it being understood that when the gas is rich or not unduly diluted with water gas, a full air supply is required to ensure complete combustion, and the regulator is adjusted so that inlet passages are fully opened and the maximum air supply is admitted into the mixing-chamber; but when the gas is poor, or impoverished with water gas, then less air is required, and the baffle-plate or regulator is adjusted so as to more or less close the inlets and admit only the requisite quantity of air into the chamber.

Washing, Scrubbing, or Enriching Coal Gas.—Browne, A. F., and McKinlay, R., of Vauxhall, S.E. No. 16,427; July 25, 1904.

This invention—having for its object to provide an improved apparatus for subjecting gases or vapours to the action of liquids or liquid agents or vapours therefrom, including the effecting of chemical reactions or physical changes by liquid agents, by agents in solution, and by agents mechanically mixed or suspended in liquids—is noticed in detail in another part of to-day's issue, p. 307.

Treatment of Heavy Tar Oils for the Manufacture of Pitch or of a Special Kind of Tar.—Rud. Rütgers, Chemische Fabrik für Theerprodukte, of Charlottenburg, Germany. No. 23,680; Nov. 2, 1904. Date claimed under International Convention, July 1, 1904.

This invention has for its principal object to utilize the heavy tar oils by converting them into pitch. The process employed consists in heating the tar oil for a considerable time, while supplying air to it which is preferably pre-heated, and then distilling, whereby pitch is produced as the residue of the distillation. The duration of the heating and simultaneous introduction of atmospheric air, the temperature to be employed, and the limit up to which the product of the reaction is to be distilled, depend on the nature of the tar oil used as the raw material, and the qualities desired for the pitch—that is to say, whether a hard or a soft pitch is to be produced.

The following example will explain the details of procedure: Ordinary impregnating oil (tar oil for the impregnation of timber) having a specific gravity of 1·079 was heated for 100 hours, while causing air heated to 100° C. to pass through it. The product thus obtained was distilled for the manufacture of hard pitch, yielding about 40 per cent. of a brilliant, black, and brittle hard pitch. If, however, the volatile constituents of the product of the reaction are not separated from the pitch by distillation, an improved kind of tar is obtained in the shape of a more or less limpid or thin liquid, which may be used as such.

Gas-Burners for Cooking and Heating Purposes.—Deutsche Continental Gas-Gesellschaft, of Dessau, Germany. No. 616; Jan. 12, 1905. Date Claimed under International Convention, March 1, 1904.

In the course of their specification the patentees say: In consequence of the large adoption of prepayment meters, there has been created a need for cheap gas-heating burners which can be used for various purposes; and endeavours have been made to employ the same burner body for various purposes by changing the burner-head. The present invention, however, is said to solve the problem more successfully, in

Fig. 1.

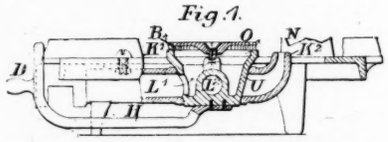


Fig. 2.

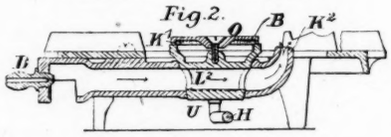
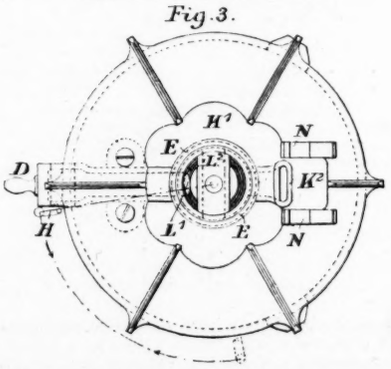


Fig. 3.



that loose parts are entirely dispensed with—the various burners being arranged one behind the other on the same mixing-pipe. The burner-head nearest to the mixing-nozzle is adapted to act as a multi-way cock in order that a simple grip or movement of the hand suffices to change the direction of the mixture from one burner to the other. One construction of burner is shown in the engraving wherein there is depicted an arrangement adapted to be alternately used as a round burner for cooking and as a flat burner for the heating of plates. It comprises an ordinary three-footed gas-burner with nozzle and mixing-pipe, which only differs outwardly from the ordinary cooking rings or burners in

that it has two burner-heads arranged one behind the other, of which the one is rotatively fitted into an expansion of the mixing-pipe and adapted to act as a multi-way cock, and the other in the usual way is cast on to the end of the mixing-pipe.

D is the gas-nozzle; M, the mixing-pipe; K^1, the round burner head for cooking; K^2, the flat burner for heating plates. K^1 is composed of the upper part O, having openings B for the gas mixture to pass through, and the hollow cone-shaped under part U. This latter is fitted into a cone-shaped expansion E of the mixing-pipe M in such a manner as to act as a cock. It can be turned through an angle of 90° by means of a lever H fastened underneath, and projecting beyond, the edge of the burner body and then bent upwards. The under part U is further provided with a bore L^1 for connecting the mixing-pipe and the hollow chamber U and also with a bore L^2 passing right through for connecting the flat burner K^2 and the mixing-pipe M.

In this way, a gas-burner is obtained which serves at the same time as cooker and plate warmer, and only costs but little more than the ordinary cooking burner or plate warmer alone. The invention can also assume different combinations—round burners and longitudinal burners, or round burners and a water-heater. The rotary part U can also be provided with more than one bore passing right through, to enable two or more burner-heads besides the round burner-head to be used and to be used separately, or by suitably arranging the bores they could be used in pairs.

APPLICATIONS FOR LETTERS PATENT.

7517.—Helps, G., "Draught screens for use with inverted mantles." April 10.
7518.—Helps, G., "Incandescent burners." April 10.
7519.—Helps, G., "Valves and seals for dry mains." April 10.
7526.—Ibbotson, F. E., and Wearden, T. I., "Supports for mantles," April 10.
7533.—Botchett, C., "Acetylene-generator." April 10.
7565.—Graham, M., "Conveyors." April 10.
7569.—Fowler, S. J., "Charging retorts." April 10.
7584.—Kent, W. G., "Liquid meters." April 10.
7608.—Rudd, J., "Cooking-stoves." April 10.
7622.—Jaques, W. E., "Gas-ovens." April 11.
7659.—Chandler, S., Mullins, E. M., and Chandler, J., "Incandescent burners." April 11.
7688.—Graham, M., "Hot-coke conveyors." April 11.
7713.—Elworthy, H. S., and Williamson, E. H., "Manufacture of gas." April 11.
7715.—Kent, W. G., "Recording the flow of liquids in pipes." April 11.
7732.—Vaudrey, P. V., "Recording at a distance changes in level of liquid in reservoirs, and for giving warning of any pre-arranged maximum or minimum level." April 11.
7743.—Harding, R. & G., "System of water supply with storage on main." April 11.
7775.—Creeke, R. W. B., and Barker, J., "Gasholder tanks." April 12.
7790.—Southall, J., "Internal combustion engines." April 12.
7791.—Dempster and Sons, R., Ltd., and Toogood, H. J., "Retort-lids." April 12.
7814.—Thompson, W. P., "Lighting gas-lamps by electricity." A communication from O. Freudenthal. April 12.
7820.—Chipperfield, W. H., "Incandescent burners." April 12.
7847.—Steffens, F., and Rothe, C., "Gas-turbine." April 10.
7848.—Barrett, S. R., "Inverted mantles." April 13.
7857.—Gill, G. M., "Incandescent burners." April 13.
7858.—Helps, G., "Incandescent burners." April 13.
7904.—Thwaite, B. H., "Suction-gas producers." April 13.
7984.—Nichols, A. E., and Brown, A. C., "Automatic bye-pass." April 14.
8044.—Ely, H., "Flexible gas-pipes." April 15.
8077.—Milne, J., and O'Connor, H., "Stop-mechanism for prepayment meters." April 15.
8080.—Besnard, C., "Gas-meters." April 15.
8088.—Burgess, J. A., "Anti-vibrators." April 15.
8106.—Hoorn, A. van, and Hemmings, J. F., "Incandescent burners." April 15.
8121.—Rowbotham, W., "Power generators." April 17.
8162.—Woods, J. E. T., "Mantles." April 17.
8164.—Davies, I. A., "Gas-saver." April 17.
8187.—Aarts, J. G., "Production of coke, ammonia, illuminating gas, tar, benzol, and other products by the distillation of coal, lignite, turf, and other carbonaceous materials." April 17.
8227.—Heys, W. G., "Gas-making apparatus." A communication from the Leede Process Company. April 18.
8249.—Kellermann, J., "Producing automatic ignition." April 18.
8432.—Helps, G., "Swivel-joints." April 20.
8433.—Helps, G., "Gas-burners." April 20.
8466.—Beal, W., "Inverted globes." April 20.
8494.—Smith, H. E., "Producer gas." April 20.
8497.—Bachner, A., "Gas-taps." April 20.
8499.—Payn, J. A., Mitchell, J., and Mowbray, C. E., "Gas-engines." April 20.
8502.—Williams, M., "Gas-producers." April 20.
8530.—Bécigneul, J. J. M., "Treatment of gas-purifying materials for the recovery of useful products." April 20.
8534.—Tangyes, Ltd., and Robson, J., Jun., "Gas-producers." April 20.
8539.—Burt, Boulton, and Haywood, Ltd., "Gas-valves." A communication from A. G. Byard. April 20.
8543.—Cook, E. S., and Chipperfield, W. H., "Increasing and equalizing the pressure of gas." April 20.
8554.—Hagspiel, W., "Liquid meters." April 20.
8590.—Noerdlinger, H., "Distilling tar, &c." April 22.
8592.—Davis, E. G., "Coin-freed meters." April 22.
8624-5.—Graham, M., "Conveyors." April 22.
8609.—Firth, A., "Gas-burners." April 22.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Institution of Gas Engineers and Gas-Testing.

Sir,—If Mr. Carr will kindly refer to Section VII., Clause 49, of the Articles of Association of the Institution of Gas Engineers, he will find that the Council have full warrant for their action in relation to the recommendations of the Board of Trade on gas-testing.

The Board of Trade recommend a method of testing which is admittedly unjust to all gas below 16 candles, and is an impossible method of testing gas of 17 candles and over. These proposals apply only to the Metropolis at present; but there can be no doubt, from past experience, that sooner or later it would be sought to extend them to the Provinces.

The Council of the Institution of Gas Engineers representing the gas industry have sought, and will continue to seek, for the withdrawal or modification of these absurd and unjust recommendations, and will press for the adoption of a method of testing that will be uniform and suitable for all descriptions of gas; and any Council that did less would betray the trust imposed upon them, and be unworthy of the confidence and respect of the Institution,

Bristol, April 29, 1905. D. Irving.

LEGAL INTELLIGENCE.

THE OMAGH GAS ARBITRATION LITIGATION.

The Award Upheld.

In the King's Bench Division of the High Court of Justice for Ireland last Thursday, before the Lord Chief Justice (the Right Hon. Lord O'Brien) and Justices Andrews and Gibson, judgment was delivered in the case of *The King v. Joshua W. Edmundson*, which was an application on behalf of the Omagh Urban District Council to make absolute a conditional order of *certiorari* to quash an award made by the defendant fixing the price to be paid by the Council to the Omagh Gas Company for the purchase of their works under the Omagh Gas Act of 1901. The case was argued on the 19th ult. (*ante*, p. 242).

The Lord Chief Justice remarked that if the question before them were to be decided out of Court by the "man in the street," his moral sense would be much offended by the attempt that had been made during the case. However, Counsel did not care for the "man in the street," and would wholly disregard him and his moral conception. It was said in such cases as this that they were in a Court of Law; that they stood for and upon the law; and that the Court, as the ministers of the law, must give the judgment the law demanded. Here a voluntary Company was in Court—a voluntary Company which owned and administered certain gas-works at Omagh; and, having been dissolved, was re-incorporated by the Omagh Gas Act of 1901, which provided that if the Urban District Council should desire to purchase the original voluntary concern, it should be valued as such, and not as the undertaking of a statutory incorporated company. The powers of the statutory Company were larger than those possessed by the original Company; and therefore the value of their undertaking would be greater than that of the original Company. The words of the 70th section of the Act of 1901, which had been relied upon to make this clear, were plain and distinct—that in case of failure to agree to terms of purchase, the matter should be determined by arbitration, in accordance with the provisions of the Lands Clauses Act; and there was also a proviso which set out that "the Arbitrator shall not, in assessing the amount to be paid by the Council to the Company, have regard to the fact that the Company is incorporated by this Act." An Arbitrator (Mr. Edmundson) was appointed, and his award was now impugned as bad on the face of it, because it showed, as alleged, that he valued the concern as belonging to the statutory incorporated Company. His Lordship said it was manifest to his mind that the Arbitrator did not, as a matter of fact, do so. His affidavit and the one made on behalf of the Company absolutely demonstrated this. Mr. Edmundson had been stated by Counsel for both parties to be a man whose *bona fides* and integrity were absolutely beyond impeachment; and he said in the most distinct and emphatic way that he valued the undertaking as belonging to the original voluntary Company. As a matter of fact, there was not any shadow of doubt about it; and it was the contention to the contrary which he had just declared would shock the sense of the "man in the street." It was, however, argued very emphatically that the Arbitrator's award showed that he did value the concern as that of an incorporated Company; and that, as they could not go behind the language of the award, the award was bad on its face, and must be set aside. In the opinion of the Court, the award was good. The question was: What was the true construction of the award to be gathered from the language employed, and what was the authority under which the Arbitrator sat? His function was to determine the amount of the purchase-money of the undertaking as that of a voluntary Company. Two things he had to make clear—first, the undertaking which was to be transferred (that was to say, the business, regarded as the property of the statutory Company); and, next, the purchase-money for the undertaking, regarded as the property of the original Company. This was the duty that the Omagh Gas Act cast upon the Arbitrator. In the award itself, he began by reciting the Act, and so to speak incorporating it as part of his award; and the operative part of it went on to say that, having been duly attended by the parties and their witnesses, and having inquired into and fully considered the value of the undertaking, he had fixed at £26,880 the sum to be paid as the purchase-money for it. First of all, it was clear, from his own words, that the property he was dealing with was the property which

he defined as belonging to "the incorporated Company;" and in the next place it was also clear that, in fixing the price, he had had regard only to the value of that property as belonging to the original voluntary Company. There was a clear distinction drawn between "undertaking" and "purchase-money." The undertaking was defined, and the purchase-money was put down as a bulk sum. Why should the Court hold, because the purchase-money was not expressly stated to be put upon each constituent detail of the undertaking, that the Arbitrator had ignored the statutory provision which prescribed his duties, and was guilty of the irregularity, or rather the illegality, of fixing the value in contravention of the 70th section of the statute which was his authority? The Arbitrator by his award purported to discharge his statutory function—to act in pursuance of the statute which defined that function; and, in his Lordship's opinion, the words "value" and "purchase-money" in the award and incorporated schedule meant the value and purchase-money assessable under the Act of Parliament and its 70th section, which was the operative one. This was enough to dispose of the contention of the District Council. The award, in his opinion, was not bad on its face; and he was also of opinion that there were substantial grounds for contending that the members of the Council were precluded, by their conduct, from applying for a writ of *certiorari*. The right to such a writ was, in his opinion, forfeited under certain conditions by acquiescence, *lâches*, and so forth. The very matters of which the Council complained were set out in the draft award which was before the Solicitors to both parties for weeks. They made no objection to its language, they never impugned its legality, and in many things, by their action, they allowed the Arbitrator to believe that the award was faultless in respect of the very matter which they now said was erroneous. This was the impression allowed to be conveyed to the Arbitrator; and there were several resolutions, agreements, and letters set out in the affidavits which showed that originally the Council recognized the validity of the award. In his judgment, to grant a *certiorari* in this case would be to pander to the *mala fides* of the Council in order that they might commit a palpable injustice. The motion would accordingly be refused.

Justice ANDREWS said he found himself wholly unable to adopt the suggestion put forward by the District Council that the Arbitrator had gone outside his legal powers. Not only was there clear evidence to the contrary, but the Court was bound, on the facts before it, to construe his award as being made, not only without violation of any of the Acts which authorized him, but in conformity with them. The District Council had full notice of the draft award, and they had ample time to object to it. They knew and considered their right to traverse the award, and they deliberately abstained from doing this. So far from raising objection to it, they treated it as valid, and entered into negotiations with a view to ascertain whether the Company would accept the sum awarded. The present proceeding was plainly an afterthought, because the sum was regarded as inconveniently large. On all these grounds, he had come to the same conclusion as the Lord Chief Justice.

Justice GIBSON concurred.

The application was therefore refused, with costs.

ILLUMINATING POWER OF THE GAS AT WEXFORD.

At the Wexford Petty Sessions last Wednesday week, the Wexford Gas Company were summoned by the Corporation for having, on March 13, supplied to the town gas having an illuminating power of 12·1 candles, instead of the statutory 14 candles prescribed in their Provisional Order of 1903.

The case was opened by Mr. M. J. O'Connor, the Solicitor to the Corporation, who explained that on the date mentioned Mr. T. J. Cotton (who was appointed Gas Tester by the Corporation last October) went to the works between half-past five and six o'clock, and found the gas to be of the illuminating power stated in the summons. On receiving a copy of Mr. Cotton's report to this effect, the Engineer (Mr. John Lyne) wrote to the Town Clerk that the test was most certainly not correct; but he did not state that he had himself made any test that night. If the deficiency had been admitted, and an undertaking given that it should not occur again, not a word more would have been heard of the case. The question for the Magistrates was whether they believed Mr. Cotton or Mr. Lyne.

Mr. Cotton described the tests he made on the day in question, and stated that Mr. Lyne accompanied him to the testing-room and stayed a few minutes with him, after which he went away and was replaced by his son Mr. A. Lyne. Witness was subjected to a long cross-examination by Mr. T. M. Healy, K.C., M.P., and admitted that during the seventeen years he had been employed in a similar capacity by the Dublin Corporation he had hundreds of times reported the gas as being under the standard; but the Corporation had never instituted a prosecution on the strength of his reports. Frequently in Dublin when he had stated that the gas was deficient in illuminating power, Professor Tichborne had reported that it was over the standard. He preferred the photometer provided at Wexford (a Letheby-Bunsen) to the one he had to use in Dublin (an old form of Evans), though he did not consider it quite up to date. He could not, in his experience, quote an instance in all Ireland of a prosecution of this kind, successful or unsuccessful. He did not recommend the present proceedings. Two tests were taken by him on the occasion referred to. This was the usual number; but if the representative of the Company asked for a third, it was generally allowed. Witness was referred at length to the evidence regarding photometry which he gave before the House of Lords on the abortive gas clauses of the Dublin Corporation Bill of 1896; and Mr. Healy also alluded to the various disputes that had taken place in that city over the gas testing.

Mr. Healy, for the Company, said that certainly in his experience of more than twenty years, this prosecution was the most novel proceeding he had been acquainted with. In Wexford, the Gas Company, at the request of the Corporation, got these statutory regulations; and after that they (the Corporation) appointed Mr. Cotton, who had been "blown upon" in every Court of the realm, and who had never before dared, while making these charges by the million against the Dublin Gas Company (nor had the people there dared), to go into Court to test them. It was most extraordinary that in Wexford alone, of all the communities of Great Britain, this prosecution should be brought. But the confession of Mr. Cotton that it was instituted against his own wish and will, and that he, the witness, upon whose evidence the case was to rest, was opposed to the proceedings, added an additional element of the bizarre to the matter; and he would suggest that an indirect motive governed the prosecution. Of course, everybody connected with Wexford—he did not blame them, and he would have the same feeling if he were a ratepayer—wanted to get the gas-works cheap. There was a clause in the Wexford Provisional Order that if within three years (and next year would be the last) the Corporation should introduce a Bill into Parliament promoted to empower them to purchase the works, the Company were not to oppose. When the Local Authority limited themselves to three years to enforce this power, the matter of purchase must have been in contemplation. They therefore brought this prosecution with the indirect object of depreciating the property. Now, Mr. Cotton had confessed to hundreds of occasions upon which he reported the Dublin gas to be under the standard; but happily in Dublin there was an independent person, Professor Tichborne, who was a Board of Trade Examiner, who every week of his life published a record in the Dublin Press, in which he gave Mr. Cotton the lie. Could any fair tribunal act on the evidence of a man who had been so discredited? Unfortunately, Professor Tichborne (who had been to Wexford to examine the testing apparatus which Mr. Cotton had condemned) was ill; but even if they had been able to produce him in Court, he was not at the works on the date in question.

The first witness for the defence was Mr. A. Lyne, the Assistant-Engineer, who stated that he was present at the tests on March 13, and that in several respects Mr. Cotton did not conform to the regulations. For one thing, Mr. Cotton did not measure the distance of the lights from the centre of the bar. On the day of Mr. Cotton's visit, he made a test at four o'clock, when he found an illuminating power of 14·14 candles. A second test after Mr. Cotton left showed 14·2 candles, and a third 14·25 candles. It would not be possible, from a manufacturing point of view, for an alteration of 2 candles to take place in the time between his tests and Mr. Cotton's. In cross-examination, witness said that since about January last the Company had been making carburetted water gas; and the only report by Mr. Cotton showing the gas to be below the standard was made after the installation of this plant.

Mr. John Lyne, the Engineer and Secretary to the Company, said that it was his wish and that of the Directors to give the public in every respect what they paid for. After Belfast, Wexford had the cheapest gas in Ireland; and they charged no meter-rent. They were invited by the Corporation to obtain their Provisional Order; and thus the Company voluntarily imposed upon themselves the conditions which that body required. He was present for a few minutes when Mr. Cotton visited the works on March 13. He had no doubt as to Mr. Cotton's competence; but it was one thing to be competent, and another to be careful. He would prefer a daily test to these surprise visits. From Dec. 8 to March 13, there was not a single test, though the Company sent out the largest portion of the gas for the year during this period. In cross-examination, witness said in his opinion Mr. Cotton was not an "impartial person" as stipulated for by Parliament. He came to this conclusion from what he read in the papers about Mr. Cotton's reports in Dublin. They were making the same gas now as they had always made. They had stopped manufacturing water gas, which was only an auxiliary to coal gas, and was not required when the long nights were over.

Mr. A. Lyne, recalled, said, in reply to the Bench, that he tested the meter when he took his first reading. Mr. Cotton did not test it. Mr. Cotton remarked that he did not test the meter because the proper instrument was not there; but he endeavoured to standardize it by means of the water-line.

After a short consultation, the Chairman (Sir William Paul, Bart.) said they were not a tribunal of experts, and they were not competent to decide whether Mr. Cotton carried out his test with more or less efficiency. He appeared to have retained all his positions; and they presumed he would not have done so if he had been incompetent. All the requirements of the Act of Parliament seem to have been complied with, although perhaps it would have been more satisfactory if the measurements had been taken and the meter tested. They considered they were justified in acting upon Mr. Cotton's certificate; and they therefore held the defendants liable in the sum of £5.

Proposed Conservation of Natural Gas in West Virginia.—The desire to save its natural gas for its own use is leading West Virginia to adopt legislation which violates the Federal Constitution. It is proposed to prohibit the piping of natural gas beyond the limits of the State. If the Federal Constitution settles anything, it is the principle of free trade between the States. An export tax upon articles carried from one State to another is not permissible. The suspension of the transportation of natural gas from one State to another would interfere with inter-state commerce. It is said that such action is seriously considered.

Proposed Gas-Works Extensions at Worthing.—As the result of the inquiry which was held at Worthing by Sir Alfred Bateman, K.C.M.G., some weeks ago, the Board of Trade have declined to sanction the application of the Gas Company for a Provisional Order to enable them to extend the area upon which they may at present manufacture or store gas. The report of the proceedings which appeared in the "JOURNAL" for March 14 (p. 724) showed that there was a considerable amount of opposition on the part of residents and property owners near the works, who contended that, though every care was exercised by the Directors and Manager (Mr. W. A. Walker) to avoid nuisance, the time had arrived when the works should be removed to a site farther away from the centre of the town.

MISCELLANEOUS NEWS.

THE PUBLIC LIGHTING QUESTION IN NEW YORK.

The Legislative Investigation.

In the "JOURNAL" last week, we gave an outline of the first day's proceedings of the Legislative Committee appointed to inquire into the circumstances attending the placing of the contract for the public lighting of New York last year. We now present the salient points in the further evidence adduced.

The main object of the Committee on the second day appeared to be to ascertain exactly how much money had been invested in the gas business in New York—not merely the amount standing in the books—in order to make it the basis for determining whether or not the profits accruing from the business are reasonable. The Consolidated Company last year paid $6,799,971 in dividends of 8½ per cent. on $80,000,000 of stock. Mr. Hughes (the Chief Counsel for the Committee) sought very hard to locate an apparent discrepancy of $12,674,770, and another of $4,538,584, between the reports made to the State Board of Tax Commissioners and the records in the books as to the value of the plant. Incidentally, much interest was aroused over the absence of Mr. R. A. Carter, the Secretary of the Company, who was said to be ill; and something like a sensation was caused when a clerk, who was called unexpectedly to give evidence, said he had seen Mr. Carter at work in the Company's office on the previous evening. Considerable surprise was occasioned by a statement that, although they paid large dividends last year, they actually had a deficit of $1,062,569 at the end of the twelve months.

The Assistant-Treasurer of the Company (Mr. B. A. Whitely) continued his evidence, which occupied practically the entire day. He stated that the first issue of stock, at the time of the organization of the Company in 1884, when consolidations of various smaller undertakings took place, was for $39,078,000, which was used to acquire the stock of the constituent Companies. A second issue was for $15,517,200, which was employed in taking up debenture bonds of the New York Gas and Electric Light, Heat, and Power Company. A third issue was for $3,773,600, and it was allocated to shares or stock of the New Amsterdam Gas Company. The fourth and last issue was for $21,631,200. It was taken chiefly by stockholders of the Company at the price of 150, producing for the Company $32,446,800. Of this last amount, $9,415,679 was used to acquire the capital stock of the Standard Gaslight Company, $33,333 for the stock of the National Coal and Coke Company, $666,043 for securities of the New Amsterdam Company, $6,462,635 for stock of the United Electric Light, Heat, and Power Company and for bonds of the Brush Electric Illuminating Company, $1,606,667 went to the Astoria Light, Heat, and Power Company, and $3,446,883 was charged to construction—making a total of $21,631,200, the exact amount of new issues of capital stock at its par value of $100 a share.

Up to this point the inquiry had proceeded most harmoniously. But when Mr. Hughes endeavoured to get an explanation of the difference between the amount accounted for by Mr. Whitely and that received from the sale of the stock at 50 per cent. premium, the serenity was slightly disturbed. Mr. Whitely was asked what became of the rest of the $11,000,000 or $12,000,000 realized from the disposition of the capital stock; and he replied that he assumed it went towards the general construction of the Company and the improvement of the concern. He added that "it increased the funds in the treasury, and was perhaps used for the purpose of paying off debts." As the result of further questions on this matter, Mr. Hughes succeeded in getting an account of all but some $5,000,000 obtained on bonds; and he then asked Mr. Whitely point-blank what had become of it. The witness replied that $1,000,000 was advanced to the Astoria Company; but as to what was done with the rest he could not tell. "Well," said Mr. Hughes, "you had better find out, as we want information on that point." Mr. Whitely said he did not think there was a living being who could give it. After some further questions Mr. Hughes succeeded in eliciting the following particulars: In the report made by the Company to the Tax Commissioners on June 30, 1904, the value of the properties engaged in the gas-making business was put down at $35,079,576—one of the items being $7,781,000 for "contract rights, franchises, &c." Deducting this, there was left a sum of $27,298,576; whereas the total amount of gas property held by the Company was put in the balance-sheet as $39,973,347. There was consequently a discrepancy of $12,674,771 in the valuation of the plant. Mr. Whitely would not admit this, because he did not, he said, know how the report had been made up or what it was intended to show. Thereupon Mr. Hughes said: "You have the report before you as a sworn statement of the assets of your Company, and you have your balance-sheet before you with the statement of your assets, and I ask you to compare the two, and tell me if there is not a discrepancy of over $12,600,000 between the items constituting the gas-making plant of your Company." Mr. Whitely was forced to acknowledge that this was so; and he confessed that he could not explain it. Asked who could, he replied: "The man who made up the report." Thereupon there was a general desire to have Mr. Carter before the Committee; and then followed the incident already alluded to in regard to his reported illness.

Another apparent discrepancy discovered by Mr. Hughes was between the statement to the Board of Tax Commissioners as to the value of the Company's mains and the valuation as shown on the books. To the Board the amount was given as $4,261,156, on the books the figures were $8,799,740—a difference of $4,538,584. Speaking for the Company, their Counsel (Mr. Mathewson) said the discrepancies discovered were only apparent. The two amounts were based on utterly different methods of calculation. In the case of the report to the Tax Board, the figures were given on what it would cost to duplicate the plant and mains, or, in other words, on the actual value on which taxes were paid; while the figures in the books were what had been actually paid out during many years to establish the plant and lay the mains. Under modern methods, the work could, he added, be done more cheaply than in the past; and much of the old work was not now serviceable. This accounted for the seeming discrepancy.

The third sitting of the Committee was a long one, and it brought out one of the main purposes of the inquiry—viz., to determine on what basis the profit of the Consolidated Company should be reckoned. It was admitted by the Company's officers that the actual value of the plant was $27,298,576, as reported to the Tax Commissioners; and the profits last year, on gas alone, amounted to $4,759,158. Taking this as a basis, the profit would be at the rate of 17·4 per cent. If to the valuation of the plant, the book value of the franchises and contract rights of the Company ($7,781,000) were added, making a total of $35,079,576, and the rate of profit reckoned on this basis, the percentage would be about 13·5. Bringing out these figures in detail, and obtaining admissions from the officers that the figures were correct, Mr. Hughes made this the feature of the day's proceedings. In further examination, Mr. Whitely computed that a profit of 8 per cent. on the Company's valuation of the plant would amount to $2,183,886·08, as compared with an actual profit to the Company on the gas business for the year of $4,759,158. Mr. Mathewson submitted that it was not just to limit the profit to a fair return on the actual value of the plant. In view of the fact that the State demanded taxes on a valuation of the franchise rights of the Company alone of more than $32,000,000, it was only right to allow them to include the rights in the property on which they might legitimately make a profit. The Company would therefore insist that the amount with which their profits should be compared to arrive at the percentage return should not be $27,000,000, but $48,000,000, with the $32,000,000 for franchise rights added, or on $80,000,000, the amount of the capital stock now issued.

The apparent discrepancies in the testimony of the previous day having been disposed of by Mr. Carter, the Secretary of the Company, by the explanation that the valuation of the plant as given in the books was based on the amount of money invested and as given in the reports to the Tax Commissioners on the actual cost of reproduction, or the present value, Mr. Hughes devoted most of his attention to scrutinizing the Company's figures going to make up the $27,000,000 reported as the cash value of the plant and mains. One amount of $45,000 for interest appeared as charged against working expenses; and he sought to learn whether $350,000 which was borrowed by the Company four years ago was laid out on plant or in the purchase of outside securities, to determine whether the charge against working expenses was a proper one. There was also an item of about $400,000 for interest on $20,000,000 of debenture bonds issued last year, which was charged against working expenses; and Mr. Hughes endeavoured to learn how much of it had gone into gas-making plant. He was only partially successful.

An interesting feature of the third day's sitting was the disclosure that when $21,631,200 of new stock was issued in 1901, the stockholders realized a profit of nearly $9,000,000. All but $900,000 of the stock was sold to them at 150; the remainder bringing 193⅜, according to the testimony of Mr. Whitely. At the same time the Company realized $33,195,906 on their stock.

At the opening of the inquiry on the fourth day, Mr. Whitely was further examined by Mr. Hughes in regard to the operations of the Consolidated Company; and he ascertained that the Company made the following purchases of gas from other Companies last year: From the New Amsterdam Company, 3487 million cubic feet, at a cost of $1,146,554, or about 32c. per 1000 feet; from the Standard Company, 675,855,700 cubic feet, for $218,717, or about 33c. per 1000 feet; from the New York Mutual Company, 738,324,300 cubic feet, for $298,722, or about 40c. per 1000 feet; and from the Central Union Company, 27,258,300 cubic feet, for $7657, or about 28c. per 1000 feet. It was thus shown that the Company had purchased at a little more than 32c. per 1000 cubic feet gas which they sold at $1. It was, however, explained by Mr. Mathewson that the 32c. was a contract figure, and that the Company had, in addition, to pay for the distribution of the gas to consumers, and to bear the cost of loss by leakage.

Mr. Hughes then endeavoured to ascertain from the witness the value of the plant and securities of the New York Edison Company; and he found that to support securities aggregating $64,500,000 of the New York Gas, Electric Light, Heat, and Power Company—the main factor in the consolidation which resulted in the New York Edison Company—there was a value at the time of the amalgamation of $19,520,700 at the outside, taking the Company's own appraisal of the plant and the bonds, stocks, real estate, and other securities at their par value. The remaining $44,979,300—approximately the amount of the capital stock of the Edison Company—was admitted by Mr. H. M. Edwards, the Auditor of the Company, to be practically a capitalization of the name of Edison, with the goodwill and similar assets of the Company. When the Edison Company was formed four years ago, it was the result of a union of the Edison Electric Illuminating Company and the Gas and Electric Light, Heat, and Power Company; the latter being known as the Power Company. The Edison Illuminating Company had capital stock to the amount of $9,200,000, and the Power Company stock to the value of $36,000,000. The two amounts were combined to make the capital of the New York Edison Company. The stock of the Illuminating Company being already owned by the Power Company, stock of the New York Edison Company was exchanged for that of the Power Company at the ratio of a fraction more than $125 for each $100 of the $36,000,000 stock of the Power Company, which brought the total issue of the New York Edison Company stock to the same amount as if it had been exchanged for both Power Company and Illuminating Company stock at par. Besides the stock issue of $45,200,000, the New York Edison Company, it was learned from the testimony of the Company's Auditor, has a funded and other indebtedness aggregating about $40,000,000. Interest on this at 5 per cent. has been paid; but no dividends have been declared. A surplus of nearly $8,000,000, however, has been accumulated in the four years the Company have been working.

Mr. Hughes made a beginning by analyzing this funded debt. He found that a mortgage of $21,000,000, to secure a bond issue of $20,900,000, had been executed by the Power Company to purchase the capital stock of the Edison Illuminating Company, amounting to

$9,200,000; the exchange being made on the basis of $220 in the 4 per cent. bonds for each share of Illuminating Company stock. By a series of questions, Mr. Hughes elicited the fact that the actual value of that for which $21,000,000 of bonds were issued, apart from goodwill, was $5,807,297, the equity in the Illuminating Company stock bought by the Power Company. From a report to the Tax Commissioners, it was learned that the Company's valuation of the plant, less depreciation, was $4,853,196. Against this there was, and still is, outstanding a funded debt of $6,500,000, which must be deducted from the assets of the Illuminating Company; leaving to be paid the $5,807,297 for which the $21,000,000 of bonds were issued.

By another series of questions, taking the Company's book valuation of the plant and other assets, which was considerably more than was reported to the Tax Commissioners, Mr. Hughes arrived at the fact that the stock for which bonds at $220 were paid was worth, according to the Company's own estimate, only $104½. It was explained by Mr. Edwards that this stock had been paying 6 per cent., and the conversion was at the rate of 8·8 per cent. interest on the capital stock. The stock for that year (1898) had been earning about 13 per cent. There was not time to investigate the actual value of the securities held by the Company; but accepting the book valuation of $1,942,388, and adding this amount to the plant valuation, together with the Company's book estimate of the value of certain Edison patents, amounting to $3,159,000, and also the floating assets of $2,353,761, Mr. Hughes obtained a total of $12,307,297 as the assets of the Company. As the result of the Auditor's examination, it was ascertained that the actual value of the properties owned by the Power Company after the various amalgamations was $19,520,700, and that against these assets stock and bonds had been issued to the amount of $64,000,000.

At this stage the inquiry was adjourned.

DEVONPORT GAS MANAGEMENT.

Terms of the Proposed New Appointment.

A Meeting of the Devonport Town Council was held on Thursday, to consider the question of the appointment of a Gas Engineer and Manager, in order to fill the vacancy caused by the resignation of Mr. Sidney E. Stevenson.

Alderman Hornbrook moved the confirmation of the report of the Gas Committee, which recommended that an Engineer and Manager be advertised for at a salary of £450 per annum, and that the age limit be 45 years. Alderman Waycott said he felt it was not wise to fix an age-limit, and also that the proposed salary was more than it was absolutely necessary to pay. He was disappointed that the Committee of Inquiry into the administration of the gas-works had not been agreed to, because, if what was said by members of the Gas Committee was true, the condition of things was not satisfactory. They had spent £60,000 with very little result; and, as a member of the Council responsible to the public, he could not support the Committee in any further action until a full inquiry had been held. He moved, as an amendment, that the age limit of 45 years be deleted from the advertisement, and the salary commence at a sum not exceeding £300. Mr. Rendle supported the amendment, but said he should have been more pleased if Alderman Waycott had proposed £250 instead of £300. He was confident that for this sum they could get a competent Engineer who would give every satisfaction. What was there after all in gas making? It was a very simple process. They had at their own works a man quite competent to fill the position; and they might promote him to it. The output at their works would remain practically stationary for many years to come; and in his opinion £250 was as much as they could afford. Mr. Bishop pointed out that £450 was £50 less than the present Engineer received. They wanted a competent Engineer, able to supervise the construction of new plant. They were paying a large salary to the Consulting Engineers—about £1000 a year; and if they could combine the Engineer and Manager and Consulting Engineer in one man, they would have a very good bargain for £450 a year. If they could not get rid of the Consulting Engineers, he should support the amendment. The Mayor, in reply to a question, stated that the house at the gas-works was not taken into consideration. Alderman Hornbrook said they reckoned the value of the house, with rates, coal, and gas, at £100 a year. Mr. Banbury remarked that, as to what had been said about the Consulting Engineers, he did not want to show their hand, but he wished the Council to think that some time in the future there would be nothing to pay for engineering expenses beyond the salary of the Manager. He did not attach much importance to the age limit; but there were members of the Committee who thought that 45 was too high. Mr. Allen supposed that if the new Engineer did occupy the house at the works, he would be charged rent for it. Alderman Hornbrook said that would be so.

After a very long discussion, a division was taken, when 15 voted for the amendment that the salary be £300 a year and the age-limit deleted; 26 voted against it; and 5 were neutral. The resolution was then adopted.

Profitable Electricity Supply in Stepney.—In the last report of the Stepney Borough Council's Electricity Committee, the gross profit is returned at a fraction over 6¾ per cent. on the capital employed at the end of the year. After providing for interest, sinking fund, and other charges, a net profit of a fraction under 2¾ per cent. has been made. The Committee point out that this profit had been earned in spite of a reduction in the price to consumers of £2300, and additional charges—viz., interest £1208, and sinking fund £1126. The net surplus is only £91 less than that of last year, though the revenue per unit has dropped from 2·36d. to 2·11d. The charge for public lighting current has also been reduced from 1·61d. to 1·55d. On the expenditure side, the cost of production has been brought down from 0·94d. to 0·85d. per unit sold; while the total cost, exclusive of interest and sinking fund, is 1·10d. per unit, which is also a reduction on the previous year.

PARIS GAS COMPANY.

Report and Accounts for the Year 1904.

The following is an abstract translation of the report of the Directors of the Paris Gas Company on the working of the undertaking in the year ending Dec. 31, with the principal items in the accounts.

In the twelve months which closed on the above-named date, there were sent from the Company's works 379,740,238 cubic metres, or rather more than 13,404¾ million cubic feet, of gas, compared with 360,987,520 cubic metres, or about 12,743 million cubic feet, in the preceding year; being an increase of 18,752,718 cubic metres, or equal to 5·19 per cent. of the total production in 1903. In that year the day consumption was 142,030,590 cubic metres, or nearly 5013¾ million cubic feet; whereas last year it was 152,752,160 cubic metres, or nearly 5392¼ millions—an increase of 378½ million cubic feet, or 7·55 per cent. of the day consumption in 1903. This class of consumption continues to augment; and it now represents about 40 per cent. of the total. The revenue from the sale of gas amounted to 102,200,101 frs. (£4,088,004), or 5,607,368 frs. (£224,295) more than in 1903. Of the total receipts, 93,103,571 frs. came from the city, and 9,096,530 frs. from the surrounding districts. These figures include the sums reimbursed to the consumers in accordance with arrangements entered into between the Company and the Municipality on the one hand, and the Company and the Société d'Eclairage, Chauffage, et Force Motrice (the new Company formed to take over the supply of the suburbs at the end of the year) on the other, to account for the reduction of 10c. per cubic metre of gas supplied for private lighting. The consumers at the close of the year numbered 553,979, compared with 526,986 at the end of 1903. They were divided into two classes: Ordinary, 334,029; and "free-fitting," 219,950. The preceding year the numbers were 321,870 and 205,116. There was consequently an increase of 12,159 in the former and 14,834 in the latter—a total of 26,993, against 35,793 for the year 1903.

The number of burners in the public lamps at the end of last December was 66,434, of which 53,971 were employed in lighting the city and 12,463 were in use in the suburbs; being an increase of 90 in Paris and a decrease of 225 in the out-districts. The extent to which the different kinds of burners are employed is shown below.

Kind of Burner.	1903.	1904.	Inc.	Dec.
Ordinary	2,969	2,286	—	683
Auer	50,840	51,519	679	—
Regenerative	72	166	94	—
Total	53,881	53,971	773	683

The substitution of incandescent burners for those of the type formerly used in the public lighting of Paris is now practically complete. The number of rising mains laid on last year was 1290; bringing up the total to 53,400. The consumers served from them at the close of the year numbered 406,955, or 24,947 more than at the corresponding time in 1903. The proportion of consumers supplied in this way is 73 46 per cent. of the total; whereas at the end of the preceding year it was 72·49 per cent.

With regard to the works and plant, the distributing system was extended by about 34,480 yards, divided fairly equally between Paris and the suburbs; bringing up the total length of mains to 2,832,650 yards—1,865,795 yards within and 966,855 yards beyond the city. There was a net sum of 887,335 frs. (£35,493) expended for capital purposes last year; and at the close the account stood as follows:—

	Francs.	Sterling.
Amount expended to Dec. 31, 1903	338,270,030	£13,530,801
,, ,, during 1904	887,335	35,493
Total	339,157,365	£13,566,294

To meet this there has been raised: By shares, 84,000,000 frs.; by bonds, 254,004,189 frs.—together, 338,004,189 frs. To this total must be added a sum of 2,246,799 frs. taken from the revenue in 1900 to meet capital expenditure in excess of 3,200,000 frs.; making in all 340,250,988 frs. (£13,610,039). From this has to be deducted a sum of 4500 frs. to be recovered on bonds. There is consequently an unexpended balance of 1,089,123 frs. (£43,565). The capital is represented by 336,000 shares and 553,332 bonds. At the date of the report, there had been redeemed 316,237 shares and 512,441 bonds; so that 19,763 shares and 40,891 bonds remain for redemption.

The following is the working account for the past year:—

Expenditure.

	Francs.	Sterling.
Value of gas in store on Jan. 1, 1904	71,857	£2,874
Manufacture of gas—		
Carbonizing material	24,396,381	975,855
Coke and tar for heating purposes	5,431,470	217,259
Salaries and wages	5,647,880	225,915
Maintenance of works and plant	2,040,807	81,632
Incidental expenses of carbonization	1,517,628	60,705
Purifying materials and labour	404,020	16,161
Distribution—		
Salaries of Engineers and officers	2,774,924	110,997
Repairs, &c., of mains and services	1,993,556	79,742
Miscellaneous expenses, stamps, &c.	570,989	22,840
Gratuitous installations of fittings, &c.	868,760	34,751
General management (including interest and sinking fund payments)	26,553,612	1,062,144
Pension and provident funds	2,761,329	110,453
Municipal charges—		
Tax of 2 c. per cub. met. of gas sold	6,610,012	264,841
Rent of subsoil occupied by mains, &c.	200,000	8,000
Lighting, extinguishing, and maintenance of public lamps (less amount paid by Municipality)	1,398,093	55,924
State charges—		
Official gas testing, stamps, &c.	1,203,245	48,130
Total expenditure	84,446,563	£3,377,863

Revenue.

	Francs.	Sterling.
Value of gas in store on Dec. 31, 1904	73,189	£2,927
Sale of gas	102,200,101	4,088,004
Residual products—		
Coke	15,533,156	621,326
Tar	2,965,197	118,608
Ammoniacal liquor	2,601,367	104,055
Rental of meters and fittings on hire	3,197,871	127,915
Interest and discount	1,174,116	46,965
Fire-bricks, &c.	27,334	1,093
Total revenue	127,772,331	£5,110,893
Deduct expenditure	84,446,563	3,377,863
Balance, profit for 1904	43,325,768	£1,733,030
Add balance from 1903	397,646	15,906
	43,723,414	£1,748,936
Deduct to meet outstanding claims	523,414	20,936
Balance available for distribution	43,200,000	£1,728,000
Deduct for share dividend	11,200,000	448,000
Balance, divisible equally between the Company and the Municipality	32,000,000	£1,280,000

The total amount coming to the shareholders is therefore—

	Francs.	Sterling.
Dividend as above	11,200,000	£448,000
Half of divisible balance	16,000,000	640,000
Placed to shareholders' credit, as per resolution of March 23, 1875	50,000	2,000
Balance of undivided profits	358,607	14,344
Total	27,608,607	£1,104,344
Deduct 1 fr. per share for reserve fund (336,000 frs.) and the complement of the share redemption fund ordered by the State Council to be borne by the shareholders (3,717,543 frs.)	4,053,543	162,142
Balance	23,555,064	£942,202
Deduct interim dividend of 12 frs. 50 c. per share paid in October last	482,287	19,291
Balance	23,072,777	£922,911

This allowed of the payment of a final dividend of 67 frs. 50 c. per share, making 80 frs. for the year; leaving a balance of 392,777 frs. (£15,711) to be carried forward. The dividend was 4 frs. 50 c. per share higher than that declared last year, which was 10 frs. 50 c. more than in 1902. In fact, this is the highest dividend paid since 1882, when it reached 82 frs. 50 c. per share. In 1898, when a decree of the State Council caused a considerable reduction in the profits, it was only 49 frs. Since then, however, it has steadily risen.

Following the accounts is the portion of the report dealing with the residual products and the gas-stove business. The revenue from the sale of coke, as already shown, was 15,533,156 frs., which was 1,628,245 frs. (£65,130) less than in 1903. Tar and chemical products, on the other hand, yielded 836,659 frs. (£33,466) more than in the preceding year. The Company's show-rooms were well visited during the twelve months, and 3830 orders received for heating and cooking stoves. Gas was also in increased demand for motive power, and 33 engines were added to the number supplied by the Company; bringing up the total to 3696, furnishing altogether 17,782-horse power. The quantity of gas consumed in this way last year was about 29 million cubic feet in excess of the consumption in 1903.

As usual, particulars are furnished in regard to the provident, pension, and savings funds. Last year the expenses of the provident fund amounted to 569,423 frs. (£22,777), whereas the receipts were only 433,064 frs. (£17,323); leaving a deficiency of 136,359 frs. (£5454), which was charged to the working account for the year. There are two pension funds—one for the workmen and the other for the clerks and officials. The amount of the former on Dec. 31 last was 2,169,676 frs. (£86,787), and of the latter 16,033,004 frs. (£641,320). Portions of each of these funds are invested in the Company's shares and bonds. The balance of the savings fund at the close of the year was 310,510 frs. (£12,420).

The remainder of the report is devoted to the negotiations which have been in progress with the authorities of the city in regard to the Company's position—their concession expiring on Dec. 31 next.

WELSBACH INCANDESCENT GAS-LIGHT COMPANY.

Annual Report.

In the report to be presented to the shareholders at the annual meeting next Monday, the Directors of this Company state that the net profit of the whole undertaking, including the dividend for the year 1903-04 upon the Company's holding in the Austrian Company, amounts (before deduction of the debenture interest) to £94,010. To this must be added £7124 carried over from last year, making in all £101,134. After providing interest upon the debenture stock to the date of its redemption, and the interim dividend for the half year upon the 6 per cent. preference shares (paid on the 2nd of January last), there remains for disposal £80,728. The Board recommend that this sum should be applied as follows: In paying a final dividend after the rate of 6 per cent. per annum on the preference shares, £17,999; in paying a dividend of 5 per cent. upon the ordinary shares for the year, £37,155; in adding to the general reserve account the sum of £15,000; and in carrying forward the balance of £10,574. The sum of £15,000 proposed to be added to the reserve, bringing this fund up to £60,000, will be invested outside the Company's business. During the year, the unredeemed balance of the 5½ per cent. debenture stock of the Company, amounting on March 31, 1904, to £61,965, was called in and cancelled. With regard to the Company's investment in the Austrian Company, the Board express their pleasure in reporting that the serious difficulties in carrying out the arrangements for the separation of the "A" (gas) and "B" (electric) undertakings of the Austrian Company, referred to at the last annual meeting, have been overcome, and that the necessary sanction of the Austrian Government to the separation has been obtained. As a result, Baron Auer von Welsbach has resumed the part interest in the Osmium electric lamp which was vested in the "B" undertaking, the "B" shares have been formally cancelled, and the

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 285.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
500,000	10	Apl. 13	10½	Alliance & Dublin 10 p.c.	21—22	..	4 15 5
160,000	10	,,	7½	Do. 7 p.c.	14—15	..	5 0 0
200,000	5	Nov. 11	6½	Bombay, Ltd.	6¾—7¼	..	4 9 8
140,000	5	,,	6½	Do. New, £4 paid	5—5¼	..	4 14 6
50,000	10	Mch. 15	14	Bourne-mouth Gas and Water 10 p.c.	29½—30½	..	4 11 10
251,810	10	,,	7	B 7 p.c.	16¾—17½	..	4 0 0
53,200	10	,,	6	Pref. 6 p.c.	15¾—16½	..	3 12 9
380,000	Stk.	Feb. 24	12	Brentford Consolidated	247—252	..	4 15 3
300,000	,,	,,	9	Do. New	187—190	..	4 14 9
50,000	,,	,,	5	Do. 5 p.c. Pref.	127—132	..	3 15 9
206,250	,,	Dec. 15	4	Do. 4 p.c. Deb.	105—108	..	3 14 1
220,000	Stk.	Mch. 15	11	Brighton & Hove Orig.	223—228	..	4 16 6
246,320	,,	,,	8	Do. A. Ord. Stk.	165—170	..	4 14 2
460,000	20	Mch. 30	10	British	40¾—41½	..	4 16 5
100,000	Stk.	Feb. 24	6	Bromley, Ord. 5 p.c.	118—123	..	4 17 7
165,700	,,	,,	4½	Do. do. 3½ p.c.	90—94	..	4 15 9
500,000	10	Oct. 13	7	Buenos Ayres (New) Ltd.	12½—13	..	5 7 8
250,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	96—98	..	4 1 8
150,000	20	Mch. 15	8½	Cagliari, Ltd.	25—27	..	6 2 3
100,000	10	Sept. 29	10	Cape Town & Dis., Ltd.	17¾—18	..	5 11 1
100,000	10	Apl. 28	4½	Do. 4½ p.c Pref.	9¾—10*	..	4 10 0
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	52—54	..	5 11 1
50,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	100—102	..	4 8 3
1,400,000	Stk.	Feb. 24	5 1/16	Commercial 4 p.c Stk.	115—118	..	4 8 1
560,000	,,	,,	5	Do. 3½ p.c. do.	111—114	..	4 7 9
450,000	,,	Dec. 15	3	Do. 3 p.c. Deb. Stk.	86—88	..	3 8 2
800,000	Stk.	,,	6½	Continental Union, Ltd.	110—113	..	5 15 1
200,000	,,	,,	7	Do. 7 p c Pref.	140—145	..	4 16 7
424,070	Stk.	Feb. 18	5½	Derby Con. Stk.	123—125	..	—
55,000	,,	Jan. 3	4	Do. Deb. Stk.	108—110	..	3 12 9
486,090	10	Jan. 27	11	European, Ltd.	22—23	..	4 15 8
354,060	10	,,	11	Do. £7 10s. paid	15—16	..	5 3 2
15,243,200	Stk.	Feb. 10	4 1/16	Gas-light 4 p.c. Ord.	95—97	−1½	4 10 10
2,600,000	,,	,,	3½	3½ p.c. max.	92—94	..	3 14 6
3,799,735	,,	,,	4	and 4 p.c. Con. Pref.	109—112	−½	3 11 5
4,193 975	,,	Dec. 15	3	Coke 3 p.c. Con. Deb.	93—92	..	3 5 3
258,740	Stk.	Mch. 15	5	Hastings & St. L. 3½ p.c.	100—103	..	4 17 1
70,000	10	Apl. 28	11	Hongkong & China, Ltd.	16—17*	..	6 9 5
3,800,000	Stk,	Nov. 11	10	Imperial Continental	218—221	..	4 10 6
473,600	Stk.	Feb. 10	3½	Do. 3½ p.c. Deb. Red.	96—98	..	3 11 5
175,242	Stk.	Mch. 15	6	Lea Bridge Ord. 5 p.c.	120—125	..	4 16 0
561,000	Stk.	Feb. 24	10	Liverpool United A	221—223	..	4 9 8
718,100	,,	,,	7	Do. do. B	164—166	+1½	4 4 4

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
306,083	Stk.	Dec. 30	4	L'rpool Unit'd Deb. Stk.	111—113	..	3 10 10
75,000	5	Dec. 15	5	Malta & Medn., Ltd.	4—4½	..	5 11 1
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	101—103	..	4 17 1
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	101—103	..	4 17 1
541,920	20	Nov. 11	3½	Monte Video, Ltd.	11½—12½	..	5 12 0
1,565,892	Stk.	Feb. 24	4½	Newc'tle & G'tesh'd Con.	109—111	..	4 3 4
406,025	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	92—93	..	3 15 3
15,000	10	Feb. 24	10	North Middlesex 10 p.c.	19—20.	..	5 0 0
52,940	10	,,	7	Do. 7 p.c.	13—14	..	5 0 0
300,000	Stk.	Nov. 30	8	Oriental, Ltd.	148—151	..	5 6 0
600,000	5	Mch. 30	7	Ottoman, Ltd.	6—6½	..	5 12 0
235,005	Stk.	—	6½	Plym'th & St'house 5 p.c.	—	..	—
398,490	5	Apl. 28	6	Primitiva Ord.	5⅞—6¼*	..	4 16 0
796,980	5	Jan. 27	5	Do. 5 p.c. Pref.	5⅞—6¼	..	4 15 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	96—98	..	4 1 8
851,070	10	Apl. 28	7	River Plate Ord.	12½—13*	..	5 7 8
300,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
250,000	10	Apl. 13	7	San Paulo, Ltd.	12⅝—13	..	5 7 8
70,030	50	Jan. 3	5	Do. 5 p.c. Deb.	52—54	..	4 12 7
135,000	Stk.	Mar. 15	10	Sheffield A	234—236	..	4 4 9
209,984	,,	,,	10	Do. B	234—236	..	4 4 9
523,498	,,	,,	10	Do. C	233—235	..	4 5 1
123,998	Stk.	Mch. 30	5	Shrewsbury Ord. 5 p.c.	107—110	+4	4 10 11
70,000	10	,,	11	South African	16—17	..	6 9 5
6,250,000	Stk.	Feb. 10	5½	South Met., 4 p.c. Ord.	127—129	..	4 5 3
1,832,700	,,	Jan. 13	3	Do. 3 p.c. Deb.	89—91	..	3 5 11
575,030	Stk.	Feb. 24	5½	S'th Suburb'n Ord. 5 p.c.	120—123	..	4 9 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	122—127	..	3 18 9
112,533	,,	Jan. 13	5	Do. 5 p.c. Deb. Stk.	130—135	..	3 14 1
502,310	Stk.	Nov. 11	5	Southampton Ord.	107—110	..	4 10 11
87,950	,,	—	4	Do. 4 p.c. Deb.	—	..	—
120,000	Stk.	Feb. 24	6¼	Tottenham A 5 p.c. and B 3½ p.c.	125—128	..	4 17 8
338,020	,,	,,	4¾		98—101	..	4 14 1
125,000	,,	Dec. 15	4	Edmonton 4 p.c. Deb.	107—110	..	3 12 9
182,380	10	,,	8	Tuscan, Ltd.	9¾—10¼	..	7 16 1
149,900	10	Jan. 3	5	Do. 5 p.c. Deb. Red.	100—102	..	4 18 0
30,000	Stk.	Feb. 24	7½	Wands-worth A 5 p.c. and B 3½ p.c. and C 3½ p.c.	163—168	..	4 12 3
255,636	,,	,,	6¼		135—140	..	4 9 3
60,000	,,	,,	5 1/16		111—113	..	4 16 0
57,564	,,	Dec. 30	3	Putney 3 p.c. Deb. Stk.	82—87	..	3 9 0
745,872	,,	Mch. 15	5	West Ham 5 p.c. Ord.	102—104	..	4 16 2
185,000	,,	,,	5	Do. 5 p.c. Pref.	123—126	..	3 19 4
193,300	,,	Dec. 30	4	Do. 4 p.c. Deb. Stk.	105—110	..	3 12 9

Prices marked * are Ex div.

"B" undertaking as part of the Austrian Company has ceased to exist. The whole control of the Austrian Company is therefore now in the hands of the "A" shareholders. As nearly all the "A" shares belong to the Welsbach Company, at the annual meeting of the Austrian Company held last autumn, the Board was entirely reconstituted by the election of nominees of the London Company. The past trading losses of the "B" undertaking have been repaid with interest; and the Austrian Company are under no future liability in connection with the Osmium light.

PRIMITIVA GAS COMPANY OF BUENOS AYRES, LIMITED.

The Annual General Meeting of this Company was held last Wednesday at the London Offices, Bank Buildings, Princes Street, E.C.—Mr. H. E. JONES in the chair.

The SECRETARY (Mr. J. H. Brouwer) read the notice convening the meeting; and the Directors' report and the accounts were taken as read.

The CHAIRMAN said, in looking back to the observations he made at the meeting last year, he found that they were somewhat lengthy. But he had much less to say to the shareholders on this occasion, because he had not now to describe to them the great change that had taken place in the undertaking through their handing over the electric lighting concern to the German Electricity Company, under the terms then explained. The record for the year was an extremely simple one, and could be put before the shareholders very shortly—indeed, it might be almost summed up in one sentence. They had successfully gone through the year, and had had some little trials, to which he would speak later. It would be seen from the report and accounts that the Directors were in the happy position of not only confirming to the shareholders the dividend of last year; but after deliberation and careful examination of the Company's prospects, they were going the length on this occasion of adding 1 per cent. more to the dividend, which last year was increased by 2 per cent. At their meeting twelve months ago, he remarked that he thought it was an extremely pleasant thing to the shareholders that they should have earned another 2 per cent.; and it was an extremely pleasant thing on this occasion to add that they had earned a further 1 per cent. As long as the present Directors had control of the undertaking, there would be no jumping up of the dividend in a manner which would make the stock a plaything of the market, or which would invalidate the future. It was only because, so far as the Directors could see, there was no prospect—short of some disaster—to diminish the 6 per cent. dividend, that they had come to the deliberate conclusion to recommend the shareholders to pay it. The report had informed them that, including the amount brought forward, they had a balance on revenue account of £132,071, as against £125,810. Out of the £132,071, they had paid the interest on debentures, which was somewhat larger—£23,665, as compared with £21,717. Their interest, discount, and commission, London expenses, fees of Directors and Trustees, income-tax, &c., was more than £1000 less than last year; the figures being £8937 as compared with £9980. The dividend on the preference shares came to £40,000, which was the same as for 1903. The Board had accepted the advice offered them by a shareholder last year, and had increased the amount written off towards the amortization of the item of "Discount on debentures" from £2500 to £4000. They had also succeeded in placing another £15,000 to reserve fund. Under these circumstances, having still a balance of £40,469, as against £36,613—after providing for the extra amortization and reserve fund—the Board felt the shareholders were entitled to receive the extra £4000; and this would still leave them with £16,469, as against £16,613. The £4000 the Board were offering to the shareholders in the shape of the 1 per cent. higher dividend. During the year, a little alteration had been made in their financing. The Company had a loan of £55,000 which appeared as a liability in last year's accounts. They paid this off by issuing an amount of 4 per cent. debentures; and the balance of the authorized issue of these debentures—amounting to £50,000—they had retained for the present as an investment; the interest received thereon (which came from the German Company, who guaranteed it) would be added to the general reserve account. The gas-works, as the report stated, had been kept in an efficient state of repair; and, of course, this was an extremely important thing in plant such as that of a gas-works. Gas, now that they had parted with the electric light undertaking, was all they had to deal with. They had spent £5300 more on the repair of apparatus connected with the outdoor department; but they had spent a little less on the works, simply because last year they were converting a very fine building which had been used in the electric lighting department to the service of the gas office. This naturally involved extra expense. The increase in the sale of gas was 4½ per cent. This might not appear to the shareholders to be a very large increase; but if they would search the records of the important gas companies, they would find that the increase in the last year or two had been rather small; and this had been properly attributed—and in their own case might be attributed with emphasis—to the fact that the introduction of the Welsbach mantle effected such a large economy in gas consumption; and those of their consumers who, under the advice of the Company, adopted this means of saving naturally used less gas than before. This was present to a large number of English companies; and it was present two-fold, so to speak, in the case of their own Company, because he might tell them that, when he joined the Board of the Company, they had hardly a Welsbach burner in use in the district. But they had been sending these burners out at the extraordinary rate of 24,000 a year. These improved burners the consumers had readily taken, so that, in two or three years, they had accomplished a change which, in the case of the larger English gas companies, had been taking place more gradually, and over a longer period. But for this there would have been a greater increase in consumption; for in the next sentence of the report,

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	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
BLACKBURN.	1,250,000	ST. CATHERINES (Remodelled) .	250,000	TONBRIDGE	300,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000	KINGSTON, PA.	125,000	STRETFORD	500,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	PETERBOROUGH, ONT. . .	250,000	OLDBURY	300,000
COLCHESTER	300,000	WILKESBARRE, PA. . . .	750,000	TODMORDEN	500,000
BIRKENHEAD	2,250,000	ST. CATHERINES (2nd Cont.) .	250,000	SALTLEY, BIRMINGHAM (Third	
SWINDON (New Swindon Gas Co.)	120,000	BUFFALO, N.Y.	2,000,000	Contract)	2,000,000
SALTLEY, BIRMINGHAM (Second		WINNIPEG, MAN.	500,000	YORK (Second Contract) . .	750,000
Contract)	2,000,000	COLCHESTER (Second Contract)	300,000	ROCHESTER (Second Contract) .	500,000
WINDSOR ST., BIRMINGHAM		YORK	750,000	NEWPORT (MON.)	250,000
(Second Contract) . .	2,000,000	ROCHESTER	500,000	TOKIO, JAPAN	1,000,000
HALIFAX	1,000,000	KINGSTON, ONT.	300,000	PERNAMBUCO (Brazil) . .	125,000
TORONTO	250,000	CRYSTAL PALACE DISTRICT .	2,000,000	MALTON	150,000
OTTAWA	250,000	DULUTH, MINN.	300,000	DULUTH, MINN. (2nd Cont.)	300,000
LINDSAY (Remodelled) . .	125,000	CATERHAM	150,000	BROCKVILLE (ONT.) . . .	250,000
MONTREAL	500,000	LEICESTER	2,000,000	SMETHWICK	500,000
TORONTO (Second Contract		ENSCHEDE (HOLLAND) . .	150,000	GRAVESEND	300,000
Remodelled)	2,000,000	BUENOS AYRES (RIVER		NEWPORT MON. (Second Contract)	250,000
BELLEVILLE	250,000	PLATE CO.)	700,000	TORONTO (Third Contract) . .	750,000
OTTAWA (Second Contract). .	250,000	BURNLEY	1,500,000	TORONTO (Fourth Contract) .	1,000,000
BRANTFORD (Remodelled) . .	200,000	KINGSTON-ON-THAMES . .	1,750,000	MONTREAL, ONT. (2nd Cont.) .	1,800,000
		ACCRINGTON.	500,000	HAMILTON, ONT.	400,000

LEEDS, 1,800,000 C. Ft. LEICESTER (2nd Cont.), 1,000,000 C. Ft. NEWCASTLE-ON-TYNE, 1,800,000 C. Ft.

AND IN ADDITION, 7,500,000 CUBIC FEET DAILY; also Coal-Gas Plants at NELSON, B.C., CHATHAM, BERLIN, NAPANEE, OWEN SOUND, CALGARY, and WINNIPEG.

it was stated that there had been a considerable growth in the use of cookers and stoves. He might say that, when the Company first started business in this direction, they were told that the habits and customs of the country were not likely to suit the adoption of these appliances, on which, in England, he knew from his practical experience, so much of the recent prosperity of the gas companies had depended. But they were not daunted by this, and very soon after their Manager (Mr. Anderson) went out, the Board forwarded specimens and types of the many varieties of these appliances as a sort of experiment. This was met by a considerable demand; and every post now brought them requests for larger consignments of the appliances. Any stove which used gas during the hours of daylight, and made no serious difference to the consumption during the hours of darkness when the gas was required for lighting, relieved very much the strain on the distributing and gasholder plant, and gave a more equal load-factor (as the electricians called it) for the retorts and works generally; so that in this direction they were confident the prosperity they now enjoyed was likely to be maintained in the future. Speaking of prosperity, of course, there was always a "fly in the amber;" and the report had told the shareholders that the Company had not escaped, as they thought at one time they would, from the effect of a sort of malaria of strikes that had been going on in Buenos Ayres during the year. They had given effective help to one of their sister companies in distress out there. They gave them all the assistance they could, and very wisely the local Directors called the men together at the time, and looked into the conditions of their employment and improved them. And so the Board had thought that probably in their case—as their men had not broken out as the other companies' men had, but were working cheerfully while the others were giving trouble—they had satisfied them. When, however, they got labour agitators moving in the field, they never knew what might happen; and, as soon as they thought the whole thing was settled, the men formulated a demand which the Directors considered unreasonable. For some time they held the men at bay. They had a most competent, energetic, and shrewd man in their Engineer (Mr. Anderson); and he had a capable lieutenant in the person of Mr. Browne, who was sent out to assist him. They and the staff made such a good show that the strikers gave in in a day or two, but with somewhat modified terms. A reasonable arrangement was come to, which relieved the hours of labour on the one side, and slightly improved the pay of the men on the other; and though it would make the cost of labour (which was already a large item in the manufacture of gas) something of a burden, he thought that he might promise the shareholders that it would not seriously affect the prospects of the future. The settlement was only come to during December last, and so it was early to say much about it. But he was sure, if it should prove next year that the extra cost of working caused a little tightness in the chest, the Directors would have the sympathy of the shareholders, because they could not escape any more than other employers of labour throughout the world from the demand of labour to have an increased share in the profits produced by its assistance. Residuals, he might say, had not been selling quite so well; but nevertheless the injury had not been great, as would be seen by the result. He had pleasure therefore in moving that the report and accounts be received and adopted, and that a dividend of 6 per cent. be declared. There was one other matter to submit to the shareholders. There had been a little misunderstanding between their Secretary and the Auditors (Messrs. G. A. Touch and Co.) as to the income-tax payable upon the Directors' fees. This the Secretary had not been deducting; and their Auditors said until this was explained at a general meeting, they could not countenance it. The Company paid the income-tax for their officers; and the Secretary had hitherto paid it for the Directors. If the shareholders ratified this by passing the report, now that it had been mentioned, the Auditors would be satisfied.

Mr. J. KINCAID seconded the motion, which was unanimously carried.

The CHAIRMAN moved that Mr. C. H. Sanford (the retiring Director, who was at present in Buenos Ayres) should be re-elected to his seat at the Board. He remarked that Mr. Sanford rendered great service to the Directors and the Company. He was a very large shareholder; and he had an intuitive knowledge of the habits and manner of thought of the authorities and people of Buenos Ayres. Consequently, he was a most valuable Director; and his annual visits were of very great assistance.

Mr. W. W. PHIPPS seconded the motion, which was unanimously adopted.

The Auditors having been re-appointed,

A hearty vote of thanks was passed to the Chairman and Directors and officers; and response having been made by the Chairman, the proceedings terminated.

THE SUTTON GAS COMPANY AND THEIR SULPHATE EFFLUENT.

The following resolution was moved by Mr. Dagg at the annual meeting of the Sutton Urban District Council: "That it having been ascertained that, notwithstanding our repeated objections, the Sutton Gas Company have connected the effluent from their sulphate of ammonia works with the public sewers, the Clerk be instructed to forthwith take such steps in the matter as will prevent what may cause irreparable damage and loss to the town." He said that the basis on which the Company founded their right to put poison in the drain was the opinion expressed by a man whom they all respected as the father of the Sutton sewerage works—Mr. Dibdin—but they put the case before him in an erroneous way, and the conditions then existing did not exist now. The sewerage system was the admiration

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of the whole world; and now, in order to increase their dividends, the Directors of a monopoly, in spite of the Council's protest, had sent this stuff into the drains. The result was that it had so percolated the bacteria beds through which it passed, that for the next two or three weeks they would be useless. The Company had either sent to sleep or killed those willing little workers, the bacteria; and the effluent now came out smelling. This was a thing which might mean ruin if it was allowed to go on; and in addition, there was the insufferable smell which came from the works. The Council had simply saved the population of the lower part of the town from drowning in order that they might be poisoned. Mr. Matthews asked if it was a fact that the effluent was ruining the sewage treatment; and the Surveyor replied that the effect upon the bacteria beds at the low-level works was very manifest. They had been seriously injured.

The proposal having been seconded, a suggestion was put forward that a Committee should be appointed to consider the matter; it being urged that, as the Company had for a time ceased these particular operations, there was no need for hurry. Mr. Hardman thought that the Committee, with the Surveyor and Medical Officer, should take observations of the effluent from the low-level beds and record them in a book properly attested, so that they might have evidence to go upon. He remarked that he, for one, was not prepared to take any steps until they had given the Gas Company every opportunity of disproving the assertion which had been made that the effluent from the low-level sewer had seriously deteriorated since the sulphate of ammonia waste had been turned into the sewers. He could not believe for a moment that the Directors of the Company, some of whom lived in the town, would, when proper evidence was brought before them, refuse to listen to the appeal of the Council that they should adopt other means of disposing of their injurious effluent. The Council should remember that they were dealing with a Company who paid heavy rates; and he thought they ought to treat the Directors with the respect due to them. If they continued their observations until they had absolute evidence that the bacteria beds were being seriously damaged and interfered with, and went to the Company with this evidence in their hands, and were unable to get a satisfactory solution of the difficulty, then would be time enough to talk of taking legal proceedings. The motion that the matter should be referred to a Committee was agreed to.

PROFITS AND LOSS AT ROCHDALE.

A Good Year for the Gas-Works.

The various trading departments of the Rochdale Corporation have been going through their accounts for the past year, and have had the satisfaction of finding that the results have been good in all cases.

First of all, of course, comes the gas undertaking, the receipts of which from all sources amounted to £86,559, against £82,452 for the previous twelve months. On the present occasion, however, there is for the first time included a sum of £5435 paid by the General Purposes Committee for lighting the street-lamps. So that, had this extra sum not been taken into account, there would have been a falling off in the receipts to the extent of some £1300. The expenditure, at £65,960, shows a reduction of £666; and the profit on the year's working is £19,598, as against £14,825 twelve months ago, when nothing was received from the General Purposes Committee. The Committee decided to hand over the whole of the £19,598 in relief of the rates; putting nothing to the reserve fund. The amount devoted to the rates a year ago was £13,000; and £5228 was taken from the reserve fund to meet the cost of the street lighting. The reserve fund now stands at about £16,000; but of this £15,500 will be required for the new water-gas plant which is being installed. It will be seen that the amount voted in relief of the rates on the present occasion is £6598 more than was handed over last year; but as £5435 is required to meet the cost of street lighting, actually the profits this time will relieve the general rates by about £1163 more than they did twelve months ago.

With regard to water, the revenue on the old works (not including Ramsden) amounted to £41,160, against £39,875 in 1903-4, or an increase of £1285. There is a profit on the old works this year of £281, as against a deficit of £698 a year ago. On the Ramsden works, the income totalled £2355, and the expenditure £5745; showing a deficit of £3390, as compared with £5162 in 1903-4. The deficiency which had to be rated for last year was £5861; whereas this year it is £3107, or £2754 less. This, it is said, means a saving of 1¾d. in the pound on the rates. On the Ramsden works the expenditure during the past year was £1738 less than in the preceding twelve months; this being more than accounted for by the fact that the repayment of the parliamentary costs loan in connection with the 1898 Act was completed a year ago.

The receipts from the electricity works amounted to £9803, against £7542 the previous year, or an increase of £2261. The expenditure totalled £8609, thus showing a profit of £1195. Of this surplus, the Committee have decided to devote £1000 to the relief of the rates. A portion of the Committee thought it unwise to make this grant; the contention being that the whole of the profit should be placed to a reserve fund to meet contingencies. On the other hand, it was argued that the rates were already very heavy in the town, and that every effort should be put forth to prevent a further increase and (if possible) to make a reduction.

Suicide by Gas.—A Coroner's inquiry which has been held into the circumstances attending the death of a young clerk who resided at East Ham showed that deceased made several determined attempts to commit suicide. First of all he cut himself with a razor, and then he took chlorodyne; but finding these efforts unsuccessful, he procured an india-rubber pipe, connected it with a gas-jet, and in this way was able to suffocate himself.

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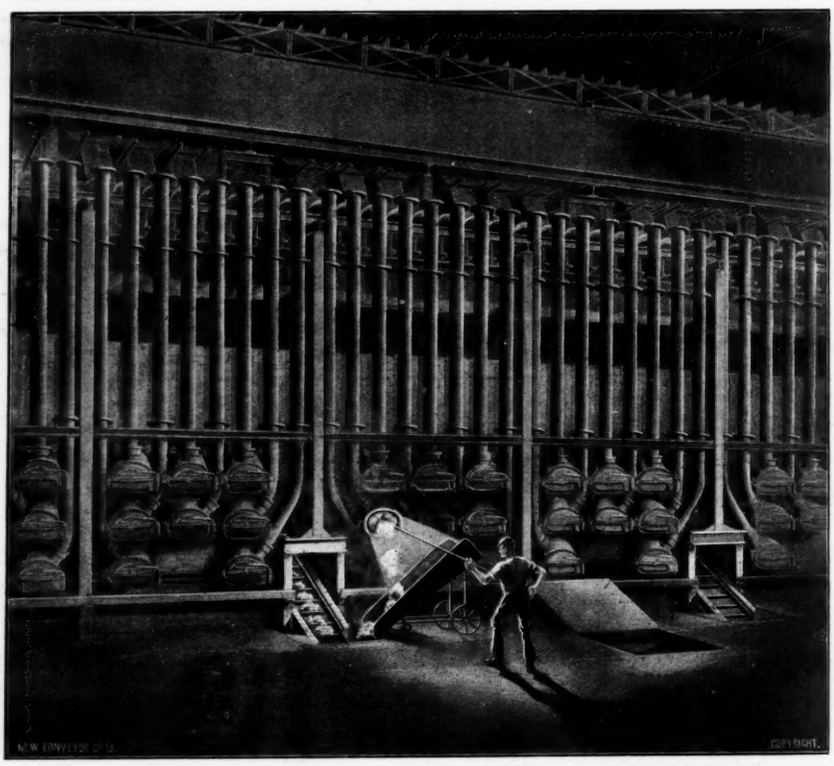

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The North British Association of Gas Managers are to meet in St. Andrews at the end of July. This week it is announced that the Gas Company there have erected a 650-candle power street-lamp in Market Street, in front of the Alexandra Hotel. This, it is stated, has been done with the consent of the Town Council, in order to give an idea of the power of street lighting by gas as compared with electricity. The members of the Association will be interested in seeing what can be done in this direction.

In a letter to the "Glasgow Herald" to-day, Mr. J. D. Affleck says he would like to call the attention of the public to the daily pilfering of gas-meters, both in occupied and unoccupied houses, which results in the destruction of personal property—the meters—and the loss of the money in them. He asks if some scheme could not be devised for doing away with coins of the realm being used in the meters. If not, he thinks that owners of houses, for their own protection, will have to discontinue authorizing the meters to be placed in their houses, as they must be the losers to the extent of some thousands of pounds per annum, to say nothing of what it is costing the ratepayers to repair the damage done to the meters. As an agent for cottage property, he had found that the first temptation to the thieves was to break into the houses for the money in the meters. If there were no money, or only a very little, then, as they put it, they must be paid for their trouble; and, in the case of empty houses, they took the gas-fittings and any lead that was procurable. He would suggest, to stop the growing evil, that users of the system might issue cheap metal tokens, and appoint shopkeepers in the various districts as agents, paying them a commission, and thus do away with a lot of the collectors who empty the money-boxes. Seeing that the tokens would be of no intrinsic value, and would be already paid for, the boxes could be emptied only at such periods as the owners found requisite. The suggestion, on its merits, is of little value, because the only reason for the employment of prepayment meters is to enable people who cannot afford to pay for gas in other than pennyworths to get gas as they get oil, in small quantities at a time; and it would scarcely pay the suppliers of gas to allow commission to shopkeepers for the sale of tokens in pennyworths. The commission which the shopkeepers would require would run away with all the profit.

A very successful exhibition of gas appliances was held in the Town Hall of Falkirk last week; the exhibitors being the Carron Company, Messrs. R. & A. Main, and the Davis Gas-Stove Company. The hall was lighted by nine Lucas lamps, supplied by Messrs. James Milne and Son. The lamps consumed 120 cubic feet of gas per hour, which was a cost of less than 5d., and gave a light equal to 4000 candles. The gas was supplied through a 1½-inch service-pipe, upon which was a Macfie governor meter. The exhibition was opened by Provost Christie, who said that the great use of a stove in the house was generally acknowledged. Time was when it was necessary at a gathering such as that to say a good deal about the advantages of the gas-stove; but he felt convinced by the fact that so many ladies were present that it was unnecessary for him to discuss those. The public of Falkirk had that day an opportunity of seeing the very best specimens of gas-stoves. The Town Council had not hitherto pushed the sale of their gas for stoves, for the simple reason that they had not a sufficient supply of gas for the purpose. Those who had gas-stoves were, of course, supplied; but the Council had not been anxious to increase the output in this connection. But it suited them now to supply all the gas that was wanted, as they were making it in larger quantities; and when the public patronized the stove industry, they were not only helping the Corporation as gas manufacturers, but were also encouraging an industry which flourished to a very great extent in the Falkirk district. The exhibits before them were the best in the market, and had all been made in Falkirk. It was reported to the Town Council on Tuesday that the Gas Committee had had under consideration the matter of the purchase of gas-stoves for the purpose of hiring, and that they recommended that the Gas Manager be authorized to purchase stoves to the amount of £1000, on the terms and conditions stated, and proposed to remit to Mr. Wilkie, the Burgh Chamberlain, and the Gas Manager to consider as to the sale of stoves. The Council approved of these recommendations.

An exhibition of the gas appliances of Messrs. R & A. Main, the Richmond Gas Stove and Meter Company, and Messrs. John Wright and Company was held in Greenock last week. The exhibition was opened by Bailie Shankland, who said that, from figures supplied to him by Mr. Ewing, the Gas Manager, it appeared that the number of gas consumers in the town was 13,250. Of those, only 390 had gas-cookers, 210 had grills, and 230 had fires and heaters. He was informed that in an English town of the size of Greenock, instead of 390 cookers, there would be something like 6000.

The works of the Larkhall Gas Company, Limited, are again under extension, owing to the increasing demand for gas. In 1898, the Company erected a new gasholder and new purifiers; and it is now found necessary to extend the carbonizing power of the works. The Directors have consequently resolved to build a new retort-house, with a bench of six ovens of six retorts each. They are to be built back to back, on the regenerative system. To make room for this extension, it is necessary to take down the Manager's house. It is intended to cover over the yard between the new building and the coal-shed; and it is also proposed to provide a workmen's room. The Engineers for the extensions are Messrs. A. Gillespie and Son, of Glasgow. The contract for the building of the retort-bench has been let to Messrs. Brown and Co., of Hamilton, and that for the supply of the roof and the inside ironwork to Messrs. Henry Balfour and Co., Limited, of Leven. The cost of the extersions is estimated at £2000. In 1896 the make of gas was 11½ million feet; now it is over 26½ million feet. The extensions will enable the Company to supply 60 million cubic feet annually. The price of gas is 2s. 11d. per 1000 feet, which is claimed to be the lowest in any town of the same size in Scotland.

ANCIENT AND MODERN

"CRUSADER." "CRUSADER."

ADVERTISEMENT OF THE RICHMOND GAS STOVE & METER CO., LTD. LONDON: 132, QUEEN VICTORIA STREET, E.C. WORKS & OFFICES: WARRINGTON & STRATFORD.

CURRENT SALES OF GAS PRODUCTS.

Week ending April 29.

Products generally seem to be a little firmer with the London makers. Crude carbolic acid, 60 per cent., which a few days ago was only saleable at 1s. 9d., now stands at 1s. 9½d., at which price considerable business has been done and refused. In the same way a large business has just been concluded in 90 per cent. benzol at 9d., less 1¼ per cent., which is an improvement. Pitch remains stationary, but is very firm, owing to the small stocks in makers hands.

It is reported in sulphate of ammonia that £12 15s. on Beckton terms has been again paid for May delivery for a large parcel. The demand is very brisk, and only a small discount on the above figure is suggested for the next few months.

LIVERPOOL, *April* 29.

Sulphate of Ammonia.

Notwithstanding the intervention of holidays, there has been good demand for immediate delivery, and all ready parcels have been disposed of at full prices. The closing quotations consequently remain at £12 11s. 3d. per ton f.o.b. Hull, £12 13s. 9d. per ton f.o.b. Liverpool, and £12 15s. per ton f.o.b. Leith. Prompt prices have also been paid for near delivery, but for May-June delivery a slight concession has been made. There has been considerable inquiry for delivery July-December and October-March; but the views of buyers are about 7s. 6d. per ton below present prices, and do not admit of business.

Nitrate of Soda.

Deliveries have been upon a satisfactory scale, and spot prices remain 11s. 1½d. to 11s. 4½d. per cwt., according to quality.

LONDON, *April* 29.

Tar Products.

There has been very little business doing during the past week, no doubt owing to the Easter Holidays. Benzol is, if anything, a trifle weaker; and an offer of 8¼d. per gallon was declined for some quantity of 90 per cent. f.o.b. London for prompt shipment. In the North, however, it is reported that sales have been made at 8d. for May-June delivery. In 50-90 per cent., there does not appear to be anything doing at present; and prices are purely nominal. There is still a fairly good inquiry for toluol for export; but so far as London is concerned, makers cannot offer any for early delivery, while for May-June the price may be taken as about 8¼d. delivered in the North. There is still a very good demand for the qualities of solvent showing a very high flash point; but for ordinary 90 per cent. at 160° there does not appear to be any inquiry at the moment. Anthracene remains unchanged; and there is really no business to report. Consumers do not seem to take much interest in the article for delivery during the present year. The market in carbolic acid remains in about the same position. There are still buyers at 1s. 9d. for May-June; but for the last six months of the year there is rather more inquiry from the Continent. Manufacturers, however, do not seem at all anxious to sell so far forward except at an improvement on existing values. In crystals, there is nothing fresh to report; and there does not appear to have been any business done during the past week in either quality. Prices therefore remain stationary. The position of creosote is unchanged. There is still a fairly good business doing in Yorkshire at 1¼d. per gallon for April-June; but in London consumers do not seem at all anxious to purchase unless at prices much under those which makers are willing to accept. It is quite evident that the largest producers expect a strong demand for export later on. In pitch, the market is practically unchanged, and there has been very little inquiry during the past week except from South Wales, where consumers appear open to purchase for delivery up to the end of the year, although, so far as prompt is concerned, they are not at all anxious to buy; being evidently well supplied. There is not much inquiry from the Continent for prompt delivery; while the prices offered in Belgium for forward are not at all tempting. London producers still ask 32s. to 33s. for forward delivery; but dealers are certainly open to accept less than these figures. The Manchester and Liverpool district is still the weakest market, especially so far as prompt delivery is concerned.

The average values during the week were: Tar, 17s. 6d. to 21s. 6d. Pitch, London, 31s. 6d.; east coast, 30s.; west coast, 28s. to 28s. 6d. Benzol, 90 per cent., 8¼d.; 50-90 per cent., 7¾d. to 7⅞d. Toluol, 8d. Crude naphtha, 3d.; solvent naphtha, 8d. to 8⅛d.; heavy naphtha, 10d. to 10½d. Creosote, London, 1½d. to 1⅝d.; North, 1¼d. Heavy oils, 2d. to 2⅛d. Carbolic acid, 60 per cent., 1s. 9d. to 1s. 9½d. Refined naphthalene, £4 to £8; salts, 12s. 6d. to 15s. Anthracene, "A" quality, 1½d. to 1⅝d.; "B" quality, unsaleable.

Sulphate of Ammonia.

Beckton quote £12 16s. 3d., but have not been able to realize over £12 15s. for early delivery; while for May-June, buyers only offer £12 12s. 6d. The South Metropolitan Company's price is still nominally £13; but there is no chance of business at this figure. In Leith, makers are very firm in their ideas, and still quote £12 15s. for early delivery; while at present they are not inclined to offer forward at any reduction on existing prices. Small sales are reported in Hull during the past week at £12 10s.; but as a rule makers ask £12 11s. 3d. to £12 12s. 6d. for prompt.

Incandescent Mantle Said to Have Caused a Fire.—According to a report which has appeared in the local Press, the dropping of an incandescent mantle on to some inflammable material in a window has been responsible for an outbreak of fire in the shop of a general dealer at Rawtenstall. Fortunately the fire was only a slight one, and was extinguished by buckets of water, without the aid of the brigade.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

PREVENTS NAPHTHALENE DEPOSITS.

OVER **120** MAXIM PATENT CARBURETTORS HAVE NOW BEEN FIXED.

Among the Companies and Towns supplied are The Gaslight and Coke Company, The South Metropolitan Gas Company, Birmingham, Leeds, Rochdale, Bristol, Sheffield, Oldham, Dundee, Perth, Dunfermline, and many other Works, both large and small, where they have been working in some instances for the past **Ten Years.**

MORE GAS & SALEABLE COKE PER TON of COAL CARBONIZED is PRODUCED; SAVING CAPITAL, LABOUR, FUEL, WEAR & TEAR, &c.

THE ENRICHMENT IS INSTANTANEOUS AND PERMANENT.

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

Dealers in Benzol, Carburine, and all other Naphthas and Oils suitable for the Enrichment or Production of Gas.

For Prices and full Particulars, apply to

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

COAL TRADE REPORTS.

Lancashire Coal Trade.

Business continues on steady lines in most departments. The demand for engine fuel of every description is all that can be desired. So satisfactory is it that coal owners in West Yorkshire, Derbyshire, and even Nottinghamshire, are striving to secure a share of the Lancashire trade. This can, of course, be done by competition in prices. The question of "Will it pay?" has to be considered. Some orders for gas coal and cannel have gone to West Yorkshire; and owing to this it is likely enough Lancashire prices for these commodities have been a trifle easier. It is reported that a syndicate of Lancashire capitalists contemplate mining operations in the vicinity of Mansfield and Worksop, and that the Wigan Coal and Iron Company intend to commence similar undertakings in the vicinity of the Dukeries. House coal is now on the down grade so far as the public demand is concerned, and is likely to continue so till the autumn.

Northern Coal Trade.

There is a steadier tone in the coal trade of the North. The opening of the Baltic ports has brought with it that addition to the demand which is usual at this time of the year; and thus the work at many of the collieries is fuller than it was—the enlargement of the trade being noticeable in steam coals. Best Northumbrian steams are quoted from 9s. 4d. to 9s. 6d. per ton f.o.b., second-class steams are steady at from 8s. 3d. to 8s. 6d. per ton, and steam smalls are from 4s. 6d. to 5s. 6d., according to quality. As to gas coals, there is a fair demand. For home use the deliveries are now less, and will probably fall further in the course of a few weeks; but there is a larger export, so that some of the collieries have a fair production, with the output well taken up. The tenders have been sent in for one or two gas-coal contracts—Riga, for instance—and the results are expected to be known in the course of a week or so. Coke is generally firm; but gas coke is easier. One company is believed to have its production sold to the end of next month at about 13s. per ton f.o.b.; but offers of fair gas coke are being made at prices considerably lower in some cases.

Scotch Coal Trade.

The volume of trade is growing, but not to any great extent. Prices, however, do not show any sign of moving as yet. Ell is in greatest request, for shipping; and splint is most plentiful, and is being pressed. The prices quoted are: Main, 7s. 3d. to 7s. 6d. f.o.b. Glasgow, ell 8s. to 8s. 9d., and splint 8s. 3d. to 8s. 6d. The shipments for the week amounted to 259,095 tons—an increase of 34,562 tons upon the previous week, and of 12,813 tons upon the corresponding week of last year. For the year to date, the total shipments have been 3,422,506 tons—302,947 tons more than in 1904.

TRADE NOTE.

West's Coke Conveying Machinery.

Contracts have been recently placed with West's Gas Improvement Company, Limited, for installations of their coke-conveying machinery for the Kensal Green works of the Gaslight and Coke Company, the Hollinwood Gas-Works of the Oldham Corporation, the Doncaster Gas-Works, and the new gas-works at Falkirk.

A Proposal to Close the Halifax Tar-Works.—The *agenda* for this week's meeting of the Halifax Town Council includes a motion by Alderman Wadsworth, the Chairman of the Gas Committee, to the effect that, "in face of the adverse result of the balance-sheet showing the working of the tar-works at the gas-works since its commencement, it is inexpedient to continue to work this department."

More Big Gas Profits at Blackpool.—At the meeting of the Gas Committee of the Blackpool Corporation last Wednesday, Mr. John Chew, the Engineer and Manager, had the gratification of announcing that, notwithstanding serious depression in the market for residuals, the gross profit for the past financial year is about £29,000, and the net profit £17,855, compared with £17,000 estimated. This is not far short of last year's record surplus of £18,002. Referring to the matter last Friday, the "Blackpool Herald" said: "Everyone will agree that this is a magnificent result, and one which reflects credit on the excellent management of Mr. Chew and his son (Mr. William Chew), the Assistant Gas Engineer." At the meeting of the General Purposes Committee the next day, a discussion took place on the question of whether or not the charges for gas and electricity should be reduced. The general feeling was that the interests of Blackpool would be best served by keeping the rates low, in order to induce people to reside in the town permanently; and in the end it was decided to reduce the charge for electricity from 7d. and 2d. per unit to 6d. and 2d., and to keep the charge for gas at its present figure.

Reduction in the Price of Gas and Electricity for Power at Stafford.—At the meeting of the Stafford Town Council last Thursday, the Gas and Electricity Committee recommended that the price of gas for power and heating for manufacturing purposes be reduced to 2s. per 1000 cubic feet, and that 2½ per cent. discount be allowed where the consumption was under 50,000 feet per quarter; 10 per cent. when it was under 100,000 feet; 20 per cent. when above this and under 200,000 feet; and 25 per cent. for a consumption of more than 200,000 feet per quarter. They also recommended that the charge for electricity for power purposes be reduced to 2½d. per Board of Trade unit, with 2½ per cent. discount where the consumption was less than 200 units per quarter, and 50 per cent. above that amount, with a minimum charge of £2 per quarter. Alderman Bridgwood explained that the reason for recommending the reduction was the competition offered by the new suction gas, which it was felt necessary to meet; and it was thought that this was the best way to meet it, especially as they could afford to do so. The price proposed to be charged would enable manufacturers to compete on more favourable terms for their productions, and workmen would benefit by getting increased employment. The recommendations were adopted.

SEASON 1905.

TAKING LINES WITH GAS COMPANIES.

The "MAIN" *Slot Cookers*

15 DIFFERENT SIZES.

Specially Designed for Hiring.

New Summer List of Cookers, Grillers, &c., now ready. Supplies, with Gas Company's Name printed on, sent on application.

R. & A. MAIN, LIMITED,

LONDON AND GLASGOW,

ALSO AT

FALKIRK, BIRMINGHAM, BRISTOL,
MANCHESTER, MELBOURNE, AND SYDNEY.

Quality of the Llanelly Gas.—A petition signed by 134 persons has been presented to the Llanelly Roads Committee asking them to take proceedings against the Gas Company for not supplying the consumers with gas of the quality and illuminating power named in the Special Act, and also to arrange for a daily test of the gas. Mr Vivian, who submitted the petition, stated that if the Committee did not soon take action, five of the signatories were prepared themselves to do so. A special meeting of the Committee is to be held to consider the matter.

The Rivington Arbitration Award.—In the "JOURNAL" for the 18th ult., it was mentioned that the Water Committee of the Liverpool Corporation intended to consider, at a special meeting, the advisability of appealing from the decision of Mr. Justice Warrington in the action brought by Mr. W. H. Lever to compel the Corporation to complete the purchase of the Rivington Estate under the award of Mr. R. E. Middleton, the Arbitrator (*ante*, p. 114). The meeting was held last Thursday, when it was unanimously decided to recommend the Council not to appeal, but to complete the purchase for £138,449, the amount awarded.

Dispute as to Charge for Water in the Isle of Wight.—A dispute has arisen between the Isle of Wight Rural District Council and the Newport Corporation in regard to the terms charged by the latter for supplying water to Osborne and the parishes of Whippingham and North Arreton. The Corporation have claimed nearly £380 from the Council, and the latter have decided not to make any further payment for the water unless it is agreed to supply it at the rate of 11d. per 1000 gallons. The Council contend that the arrangement to pay the sum they had been charged was made under an alleged mistake by the Corporation as to a royalty to the landlord from whose land the water is obtained. The Corporation had the matter under consideration at a recent special meeting, when it was decided to take Counsel's opinion.

Extensions at the Darlington Gas-Works.—Last Thursday, Mr. M. K. North, M.Inst.C.E., held an inquiry at the Darlington Town Hall into the application by the Corporation to borrow £50,000 for gas-works purposes. Under their Act, the Corporation can borrow £150,000, of which sum £72,000 remains unappropriated; and the Council wish to have £50,000 of the balance. The Town Clerk (Mr. H. G. Steavenson) said the works to be undertaken were a retort-house, a high-level railway, coal and coke handling plant, liquor-tank, and additional land, with contingencies. Some of the contracts had been let provisionally, and the Gas Committee were anxious to proceed with the work to meet the demands of the town. It was stated that the profit from the gas-works last year, which went in relief of the rates, was £9903.

Cookery Demonstrations at Port Elizabeth.—The indefatigable Manager of the South African Lighting Association (Mr. William Arnott) is determined that the residents shall not be ignorant of the value of gas, especially for culinary purposes. He recently organized two courses of lectures and demonstrations by Miss Mabel Smallwood, of London, and they were attended by large and appreciative audiences. On Monday, the 3rd ult., this lady cooked a complete dinner of six courses in an hour. Contrary to custom, a charge was made for admission to this demonstration; but the proceeds were devoted to the Children's Home, the Committee of which were present. In the preceding week there was a bachelor's breakfast competition, which caused great amusement. However, Mr. Arnott's object was achieved—namely, to bring under notice the appliances which he is prepared to supply, and of which he keeps a large stock in his show-rooms. He follows up the effect of the demonstrations by the distribution of a small pamphlet on the economy and advantages of cooking by gas, in which, in the compass of eight pages, he furnishes convincing proof that the claims he makes for it are fully justified.

The Serious Gas Explosion at Birmingham.—The first reports of the gas explosion which occurred on Good Friday in Sherborne Road, Balsall Heath, Birmingham, did not mention the cause of the accident; but later accounts state that the gas supply to the damaged building (which is jointly occupied by a screw manufacturer and a brass factor) is conveyed through two meters, one of which is reserved entirely for illuminating purposes, while from the other there are branches to two gas-engines. One of these has recently been out of use; and it is suggested that an escape may have arisen in connection with the turning of the gas into a defective pipe which supplies this engine. A slight smell of gas was detected during the morning; but it was not considered sufficiently serious to call the attention of the Gas Department to it. Work involving the use of the engines, one of which was being repaired, was carried on throughout the day; and late in the afternoon the smell of escaping gas in the front part of the building became so pronounced that an investigation was made as to the cause. The meters were located in the front basement; and it is supposed that someone either struck a light or left open the door of the room in which a fire was burning.

Suffocation by Coal Gas.—A Benedictine monk from Kidwelly, named Father Gowan, who assisted in the services at St. David's Roman Catholic Church, Swansea, on Easter Sunday, was found dead in bed at St. David's Priory, Swansea, the next day. He retired to rest at ten o'clock on Sunday night, and was to have celebrated early Mass on the Monday morning; but when called by the housekeeper at seven o'clock there was no response. On the door being opened, the gas was found to be turned on; and it was supposed that, on rising in the early hours to say his offices, the deceased inadvertently turned the gas on again instead of turning it off, as he supposed. Mme. Eugénie Buffet, a lady who some years ago interested Paris by becoming a strolling singer for a charitable undertaking, recently had a very narrow escape from death by inhaling coal gas. Her young daughter went out, leaving Mme. Buffet alone. On returning some hours later, the girl rang and knocked in vain, then fetched a policeman, who broke open the door, which had been fastened with a chain. Mme. Buffet was lying insensible on her bed, and the room was full of gas. Help had come just in time, and she was restored. The escape of gas was due to a small stove on which she had put water to heat in a saucepan. She had lain down and dozed off, when the water boiled over and put out the gas, which must have escaped for upwards of three hours.

THE

PARKINSON

"CROWN"

COOKER

SHOWING HOT-PLATE

HINGED TO FACILITATE

CLEANING OF BURNERS, &c.

PARKINSON AND W. & B. COWAN, LTD.

(*Parkinson Branch*),

COTTAGE LANE, CITY ROAD, LONDON.

BELL BARN ROAD, BIRMINGHAM.

The Closing of the Radford Works at Nottingham.—The Nottingham Corporation Gas Committee, in the course of a supplemental report regarding the proposed extension of the Basford works and the condition of the Radford station, deny that it is their intention to entirely close the latter. This course, they say, might possibly have been adopted, with advantage to the undertaking generally, ten years ago; but since that date the consumption of gas has increased by 43 per cent., while the storage capacity has not been enlarged to anything approaching a corresponding amount. It will therefore be necessary for several years longer to work all the available plant at Radford during the winter months.

Acetylene as an Illuminant.—The following remarks on the above subject appeared as a "Note" in the Engineering Supplement to "The Times" on Wednesday last: "It is curious how the expectations (which did not appear at all extravagant at the time) associated with the advent of acetylene as a public illuminant have been disappointed. The ease and simplicity with which the gas could be generated, its immunity from any marked form of danger, and the cost at which it could be produced, which, though high, could not be considered to be in any way prohibitive, associated prospects with the new discovery which the experience of the past five years has done but little to fulfil. It may be fairly said that the vast body of the public are unfamiliar with a light which it was confidently anticipated would revolutionize the whole conditions of isolated lighting, and be successful in displacing all other forms of illumination for railway carriages, tramcars, and omnibuses. It is true that a number of London street omnibuses entered into a contract for the acetylene lighting of their interiors; but after a short period they reverted to the smoky oil-lamps to which the public have become inured, and little or nothing of the light in that form of application has been heard since. The main obstacle in the utilization of acetylene for a single or for a limited number of lights is undoubtedly the difficulty of securing an equable rate of generation from the carbide. This might be avoided by compression; but unfortunately acetylene condensed under pressure has the faculty of exploding from a cause which does not even yet appear to be thoroughly explained."

The Globe Light, Limited, have removed from 20, Regent Street, to more commodious premises at 138, Gray's Inn Road, E.C.

The Directors of the Oriental Gas Company, Limited, have resolved to pay an interim dividend at the rate of 3½ per cent., free of income-tax, on account of the year ending the 30th of June next.

The Directors of Meldrum Brothers recommend a final dividend of 4 per cent. on the ordinary shares; making, with the interim dividend paid, 8 per cent. for the year 1904. A balance of £1326 will remain to be carried forward.

The German Gas-Tube Export Syndicate, of Düsseldorf, have appointed as their sole agents for Great Britain and Ireland Messrs. Charles Hatton and Co., of 107, Upper Thames Street, E.C., and Mr. Edward Lomer, of 12, St. Mary Axe, E.C.

Messrs. F. C. Sugden and Co., of Leeds, have had orders placed with them for regenerator settings and ironwork by the St. Ives (Hunts) Gas Company, Limited, the Abertillery Urban District Council, and the Alton (Hants) Gas and Coke Company. They have also had an order from Birmingham.

The shortage of water in the reservoirs supplying Sheffield is so great that the Chairman of the Water Committee (Mr. Alderman Gainsford) recently informed the Council that the amount paid to millowners in respect of the retention of compensation water would have to be continued at the rate of £70 per day until the storage was sufficient to meet the summer season.

Messrs. Le Grand and Sutcliffe have lately carried out some rapid well-boring operations at Cheshunt. The boring is 8½ inches in diameter, and, after passing through 21 feet of alluvial clays and gravel, penetrated the Woolwich and Reading beds and Thanet sands, reaching the chalk at 75 feet; and it was completed in the short space of 13 days, to the total depth of 201 feet. An exhaustive pumping trial has since been made, which demonstrated a yield of more than 6000 gallons of water per hour.

WANTED, FOR SALE, CONTRACT, &c. ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

MANAGER, &c. Ennis Gas Company.
ENGINEER AND MANAGER. Devonport Gas Department. Applications by May 8.
REPRESENTATIVE (GAS APPARATUS). Sell's Advertising Offices.
WATER ENGINEER. Lincoln Corporation. Applications by May 9.
GAS METER INSPECTOR. Edinburgh Gas Meter Department. Applications by May 15.

Situations Wanted.

GAS-FITTER, &c. Gibson, Wellingborough.

Investment Wanted.

Gould's Advertising Offices.

Tank Waggons to Let.

CLAYTON ANILINE COMPANY.

Company Meetings.

PORTSMOUTH WATER COMPANY. Offices, May 25. Three o'clock.

Plant, &c., for Sale.

CONDENSER. Redditch Gas Company.
WASHER-SCRUBBER AND CONNECTIONS, &c. Rawmarsh Gas Department.

Stocks and Shares.

BRIXHAM GAS COMPANY. May 13.
CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY. May 16.
FELIXSTOWE GAS COMPANY. May 16.
ILFORD GAS COMPANY. May 23.
LOWESTOFT WATER AND GAS COMPANY. May 16.
PORTSMOUTH WATER COMPANY. May 18.
SOUTHEND WATER COMPANY. May 16.
WANDSWORTH AND PUTNEY GAS COMPANY. May 16.
WOKINGHAM WATER COMPANY. May 16.

TENDERS FOR

Benzol.

LEIGH CORPORATION. Tenders by May 13.

Coal and Cannel.

BALLINA GAS COMPANY.
BARROW-IN-FURNESS GAS DEPARTMENT. Tenders by May 24.
BURTON-ON-TRENT GAS DEPARTMENT. Tenders by May 18.
HAYWARD'S HEATH GAS COMPANY. Tenders by May 6.
LEIGH CORPORATION. Tenders by May 13.
OLDHAM GAS DEPARTMENT. Tenders by May 16.
RICHMOND TOWN COUNCIL. Tenders by May 29.
SOUTH STAFFORDSHIRE WATER DEPARTMENT. Tenders by May 15.
STAMFORD AND ST. MARTIN'S GAS COMPANY. Tenders by May 17.

Conveying, Screening, and Storing Plant.

PAISLEY GAS CORPORATION. Tenders by May 13.

Creosote Oil.

LEIGH CORPORATION. Tenders by May 13.

Electric Power Generating Plant.

PAISLEY GAS CORPORATION. Tenders by May 13.

Lead Piping (Gas and Water).

LEIGH CORPORATION. Tenders by May 13.

Lime.

BURTON-ON-TRENT GAS DEPARTMENT. Tenders by May 18.
LEIGH CORPORATION. Tenders by May 13.

Oil for Gas Making.

BARROW-IN-FURNESS GAS DEPARTMENT. Tenders by May 24.

Pipes and Specials.

LEIGH CORPORATION. Tenders by May 13.

Pitch.

LEIGH CORPORATION. Tenders by May 13.

Purifiers, &c.

COVENTRY GAS DEPARTMENT. Tenders by May 15.

Sulphuric Acid.

LEIGH CORPORATION. Tenders by May 13.

Tar and Liquor.

BURTON-ON-TRENT GAS DEPARTMENT. Tenders by May 18.
LEIGH CORPORATION. Tenders by May 13.
WAKEFIELD GASLIGHT COMPANY. Tenders by May 10.

OXIDE OF IRON.

O'NEILL'S OXIDE has a larger annual sale than all other Oxides combined.
SPENT OXIDE purchased in any district.
GAS PURIFICATION & CHEMICAL CO., LD.
JOHN WM. O'NEILL, Managing Director,
PALMERSTON HOUSE, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.
BROTHERTON AND CO, LTD., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 54 & 47, Westminster Bridge Road, LONDON, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
Telephones: 254 Oldham, and 2412 HOP, London.
Telegrams:—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

DUTCH OXIDE OF IRON.
SPENT OXIDE PURCHASED IN ANY DISTRICT.
THE First Dutch Bogore Co., Ltd., HOLLAND.
General Manager (for England and Wales)—
CHARLES E. FRY, LEAMINGTON.
General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

GAS TAR wanted.
BROTHERTON AND CO., LTD., Tar Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, AND WAKEFIELD.

OXIDE OF IRON.
(NATURAL.)
BALE & CHURCH will be pleased to send Quotations and Samples on application.
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT for all Retort and Furnace work.
PAINT for Gasholders, Purifiers, &c.
5, CROOKED LANE, LONDON, E.C.

SULPHURIC ACID.
SPECIALLY prepared for the Manu- facture of SULPHATE OF AMMONIA.
SPENCER, CHAPMAN, AND MESSEL, LIMITED, 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 341, AVENUE.

JOHN RILEY & SONS, Chemical Manu- facturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 Years. References given to Gas Companies.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

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COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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All Communications, Remittances, &c., to be addressed to
WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central.

BROTHERTON & CO., LIMITED.
Offices: Commercial Buildings, LEEDS.
Correspondence invited.

SULPHATE OF AMMONIA
SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness, with efficiency for Repairs.
JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.
Telegrams: SATURATORS, BOLTON. Telephone 0848.

PATENTS AND TRADE MARKS
PUBLICATIONS, "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 and 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

BIGGS, WALL, & CO., 13, Cross Street,
Finsbury, E.C. *Telegrams:* "RAGOUT," LONDON.
Telephone: 273 CENTRAL.
EXHAUSTING MACHINERY—See Advt. in last week's issue.
SULPHATE PLANTS—See Advt. in this week's issue.
CHARGING MACHINERY—See Advt. in next week's issue.

ATTERTON'S Patent Charging
Machine, especially adapted for Small Works up to 50 Millions. Nearly 40 already supplied, and still supplying. Would soon repay for small outlay. Increased make and reduction in cost.
Apply to E. PADFIELD AND CO., 96 & 98, Leadenhall Street, LONDON, E.C.

"VITERNUS" METALLIC PAINT FOR GAS-WORKS PLANT.
JOHN E. WILLIAMS AND CO.,
LOWER MOSS LANE,
MANCHESTER, S.W.
Telegrams: "ENAMEL." National Telephone 1759.

SPENT OXIDE.
THE South Metropolitan Gas Company
are always open to receive OFFERS of SPENT OXIDE.
Chief Office: 709, Old Kent Road, London, S.E.
Telegrams: "METROGAS, LONDON."

AMMONIACAL Liquor wanted.
BROTHERTON AND CO., LTD., Ammonia Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, AND WAKEFIELD.

GLASS SHADES of every description,
for all kinds of Interior **GAS LIGHTING.**
Illustrated sheets on application.
JOHN WALSH WALSH,
SOHO AND VESTA GLASS WORKS, BIRMINGHAM.
Telegrams: "VESTA, BIRMINGHAM."
National Telephone: No. 63.
London Show-Room: 4, HOLBORN CIRCUS, E.C.

YOUNG Man wants situation as Gas-
FITTER. Five Years' Experience at Gas-Works. Used to Iron and Compo. Had considerable Experience in Slot Installations, Incandescents, &c. Age 21.
Address J. W. GIBSON, Gas Cottages, London Road, Wellingborough, NORTHANTS.

REQUIRED by a large firm of Gas
Lighting Engineers and Gas Apparatus Makers, a REPRESENTATIVE, resident in Manchester, for Manchester and the North-Western Counties. Must have good Connection among Gas Companies, Local Authorities, Architects, Ironmongers, &c.
Address, stating Age, Experience, and Salary and Expenses expected, with *copies* of Testimonials, to Box 2936, Sell's Advertising Offices, LONDON, E.C.

THE Ennis Gas Consumers Company,
Limited, require the services of a man as MANAGER and GAS-FITTER. Must be a good Carbonizer and understand Regenerative Furnaces and Gas-Engine and Exhauster, and be Experienced in Main and Service Laying and Gas-Fitting. Married man preferred. Salary 30s. per week. House, Fuel, and Light free.
Send Two recent Testimonials with Application to the SECRETARY, Gas-Works, Ennis, Co. CLARE.

ROBERT DEMPSTER & SONS, Ltd.,
Contractor for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, ROSE MOUNT IRON-WORKS, ELLAND.

GASHOLDER PAINTING.
PAINTING Work for all kinds of Gas-
Works Plant undertaken by contract or otherwise.
FREDERICK BOYALL, 31, Regent's Row, Queen's Road, DALSTON, N.E. Established 1850.

GAS-METER INSPECTOR.
CHIEF Inspector for the City of Edin-
burgh Gas-Meter Department.
Salary £200 per annum.
Applications, with Ten *copies* of Testimonials, must be lodged with Mr. LYON, Deputy Town Clerk (Magisterial Department) City Chambers, EDINBURGH, by the 15th of May next.

COUNTY BOROUGH OF DEVONPORT.
GAS ENGINEER AND MANAGER.
THE Devonport Corporation invite
APPLICATIONS for the Appointment of an Experienced and Qualified man as ENGINEER and MANAGER of their Gas-Works.
Salary £450 per Annum. Age not to exceed 45.
Appointment determinable by Three Months' notice on either side.
The gentleman appointed must devote the whole of his time to the duties of the Office.
Applications, stating Age, Experience, and Qualifications, with *copies* of not more than Three recent Testimonials, to be sent to me on or before Monday, the 8th day of May, 1905, endorsed "Gas Engineer."
R. J. FITTALL,
Town Clerk.
Municipal Offices, Devonport,
April 27, 1905.

CITY OF LINCOLN.
PUBLIC HEALTH ACT, 1875.
LINCOLN CORPORATION WATER-WORKS.
TO WATER-WORKS ENGINEERS.
THE Corporation of the City of Lincoln
invite APPLICATIONS for the Appointment of a WATER-WORKS ENGINEER.
Candidates must have had previous Experience in a similar capacity with a Company or a Corporation supplying water to a town or district under Parliamentary Powers, and be competent to Superintend the Laying of Mains and the Management of Filter-Beds, Engines, Plant and Machinery, and the General Conduct of a Water-Works undertaking.
The Engineer appointed will be required to devote the whole of his time to the service of the Corporation.
The Salary will be at the rate of £300 per Annum.
Applications, stating Age, present Occupation, and giving an account of previous Experience as a Water Engineer, in the Candidates' own hand-writing, together with not more than Three recent Testimonials, must be sent to me, endorsed "Water-Works Engineer," on or before the 9th day of May, 1905.
Canvassing for the appointment will disqualify a candidate.
By order,
W. T. PAGE, Jun.,
Deputy Town Clerk.
Lincoln, April 25, 1905.

A GENTLEMAN with many Years'
Business Experience seeks an INVESTMENT in either Brewery, Gas, Water, Railway, or Tramway Company, where a large holding in Preference or Debenture Shares would secure a seat on the Board of Direction.
Write "GENUINE," care of Gould's Advertising Agency, 54, NEW OXFORD STREET, W.C.

TO LET ON HIRE
CYLINDRICAL Tank - Waggons,
suitable for the carriage of Benzol or Crude Naphtha.
Apply to the CLAYTON ANILINE COMPANY, LIMITED, Clayton, MANCHESTER.

NEW Gasholder, 40 ft. diameter by
12 ft. deep, with Steel Standards; also new STEEL TANK to contain same.
Write J. WRIGHT, 181, Queen Victoria Street, LONDON, E.C.

REDDITCH GAS COMPANY.
CONDENSER for Sale (water cooled),
faced joints. First-Class Condition. Capacity 250,000 per day.
Particulars, &c., from A. E. LAYTON, Manager.

TEST PLANT FOR SALE—We have
several small Sets of GAS APPARATUS suitable for Test Plants, including Retorts, Condensers, Scrubber, Purifiers, Gasholders, overhauled and guaranteed, or New throughout.
FIRTH BLAKELEY AND CO., Thornhill, DEWSBURY.

PURIFIERS, &c., FOR SALE—Sets of
4 ft., 5 ft., 6 ft., 8 ft., 9 ft., 10 ft., 12 ft., 18 ft. squares; also 16 ft. by 12 ft., &c. SCRUBBERS, 8 ft. by 60 ft. 10 inch, 18 inch Square METERS. EXHAUSTERS up to 50,000 feet per hour in Stock. GASHOLDERS and TANKS, also New. State requirements
FIRTH BLAKELEY AND CO., Thornhill, DEWSBURY.

GAS PLANT for Sale—I can always offer
NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

RAWMARSH URBAN DISTRICT COUNCIL.
THE Gas Committee have for Sale a
Kirkham, Hulett, and Chandler "Standard" WASHER-SCRUBBER, with 10-inch Valves, Connections, &c., capable of passing 200,000 cubic feet per day. It is being replaced by a larger one, and can be seen working at the Gas-Works, Parkgate, Rotherham.
For further Particulars, apply to E. O. WATSON, Gas Manager.

BOROUGH OF BURTON-UPON-TRENT.
THE Gas Committee invite Tenders
for:—
GAS COAL.
The supply of 32,000 Tons of best screened GAS COAL and 3000 Tons of CANNEL, to be delivered in Sender's or Railway Company's Waggons at the Gas-Works during the Twelve Months ending June 30, 1906, in accordance with the Form of Tender and Conditions which may be obtained from the undersigned.
Intending Contractors must state in their Tender what allowance they will make from the tendered price if the Coal is carried in the Gas Committee's Waggons.
LIME.
The supply of about 300 Tons best Hand-Picked LIME for Purifying to be delivered in Sender's or Railway Company's Waggons at the Gas-Works in such quantities and at such times as may be required during the Twelve Months ending June 30, 1906.
TAR.
The purchase of the surplus TAR which will be produced and delivered into the Purchaser's Tank-Waggons at the Gas-Works during the Twelve Months ending June 30, 1906.
Terms of Payment, Net Cash Monthly.
Tenders, endorsed "Coal," "Lime," and "Tar" respectively, are to be delivered to the undersigned on or before Thursday, the 18th day of May, 1905.
The Committee do not bind themselves to accept any Tender.
F. L. RAMSDEN,
Manager and Engineer.
The Gas-Works, Burton-upon-Trent,
May 2, 1905.

BOROUGH OF RICHMOND WATER-WORKS AND PUBLIC BATHS.
TENDERS FOR SMOKELESS WELSH STEAM COAL.
THE Town Council of the Borough of
Richmond (Surrey) invite TENDERS for the supply of about 1450 Tons of best WELSH SMOKELESS COAL, to be delivered in Barges of about 40 Tons alongside the Wharf opposite the Water-Works, Richmond, for One Year from the 1st day of July, 1905, to the 30th day of June, 1906.
The seam and district from which the Coal is to be supplied must be stated in the Tender.
Particulars and Forms of Tender can be obtained of Mr. W. G. Peirce, Borough Water-Works Engineer, at the Water-Works.
No Tender will be recognized unless it is made on the prescribed Form, properly filled up in every respect; and no Expenses or claim will be allowed or paid to any person whether Tendering or not.
The security stipulated by the Public Health Act, 1875, for the due performance of the Contract will be required, and the Contract and Bond will be prepared by the Town Clerk.
Sealed Tenders, endorsed "Tenders for Welsh Coal," and addressed to the Chairman of the Water Committee, Borough of Richmond (Surrey), must be delivered at the Town Clerk's Office, by Ten o'clock on Monday, the 29th of May, 1905.
The Council do not bind themselves to accept the lowest or any Tender.
FREDK. B. SENIOR.
Town Clerk.
Town Clerk's Office, Town Hall,
Richmond (Surrey).

BOROUGH OF BARROW-IN-FURNESS.

SUPPLY OF COAL AND CANNEL.

THE Corporation are prepared to receive TENDERS, on Forms to be obtained at the Office of the Gas and Water Manager, for the supply of screened GAS COAL and CANNEL for the Year ending the 30th of June, 1906.

Tenders, addressed to the Chairman of the Gas and Water Committee and endorsed "Tender for Coal," to be delivered at the Town Clerk's Office, not later than Twelve o'clock noon on Wednesday, the 24th day of May, 1905.

The lowest or any Tender not necessarily accepted.

By order,
C. F. PRESTON,
Town Clerk.

Town Hall, Barrow-in-Furness.

BOROUGH OF BARROW-IN-FURNESS.

SUPPLY OF GAS OIL.

THE Corporation are prepared to receive TENDERS for the supply of about 300 to 400 Tons of OIL, suitable for the Manufacture of Carburetted Water Gas, delivered free at the Gas-Works Siding, in such quantities and at such times as may be required during the period ending the 30th of June, 1906.

Sealed Tenders, addressed to the Chairman of the Gas and Water Committee and endorsed "Tender for Oil," to be delivered at the Town Clerk's Office, not later than Twelve o'clock noon on Wednesday, the 24th of May, 1905.

The lowest or any Tender not necessarily accepted.

By order,
C. F. PRESTON,
Town Clerk.

Town Hall, Barrow-in-Furness.

HAYWARDS HEATH DISTRICT GAS COMPANY.

GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 3400 Tons (more or less) of GAS COAL, to be delivered in such quantities and at such periods as may be ordered between the 1st of July, 1905, and the 30th of June, 1906.

The Coal required is to be unscreened, and to be delivered, in Trucks, free at the Haywards Heath Railway Station (London, Brighton, and South Coast Railway) in good and dry condition, either from the South Yorkshire or Durham Coalfields.

Payments, net cash monthly.

Tenders are to state the name of the Pits from which the above description of Coal will be supplied; the same to be fresh wrought, and free from Slate or other objectionable matter for Gas Making, and to the entire satisfaction of the Company's Manager.

Each delivery to be accompanied by a certificate stating place of origin and Railway weight of each truck.

The Directors have no special Form of Tender, and do not bind themselves to accept the lowest or any Tender.

Tenders are to be received by me on or before Saturday, the 6th day of May next, and endorsed "Tender for Gas Coal."

(Signed) RUSSELL CORY,
Secretary.

85, Gresham Street,
London, E.C.

BOROUGH OF LEIGH.

(GAS DEPARTMENT.)

THE Gas and Water Committee of the above Corporation invite OFFERS for the surplus TAR made at their Gas-Works during the Twelve Months ending June 30, 1906. The Corporation are also prepared to receive TENDERS for the supply and delivery of PITCH and CREOSOTE OIL during the same period.

Further Particulars, together with Conditions of Contract and Forms of Tender, may be obtained on application to the undersigned.

Sealed and endorsed Tenders must be delivered to Mr. Stanley Wilson, Town Clerk, Town Hall, Leigh, Lancashire, on or before Twelve o'clock noon on Saturday, the 13th day of May next.

The Corporation do not bind themselves to accept the highest Tender for Tar, or the lowest for Pitch and Oil, or any Tender, and reserve to themselves the right to divide any Tender.

JAMES GIBSON,
Engineer and Manager.

Gas and Water Offices,
Leigh, Lancs.

BOROUGH OF LEIGH.

(GAS AND WATER DEPARTMENT.)

THE Gas and Water Committee of the above Corporation are prepared to receive TENDERS for the supply of the following GOODS:—

1.—12,000 Tons of Screened and Unscreened Gas Coal, Nuts, and Slack.
2.—Lead Piping (Gas and Water).
3.—Vitriol.
4.—Lime.
5.—Benzol.
6.—3-inch, 4-inch, and 7-inch Cast-Iron Pipes and Specials.

Forms of Tender may be had on application from the undersigned, to whom all Inquiries must be addressed; and all Offers must be made on the Official Forms, or they will not be considered.

Sealed and endorsed Tenders must be delivered to Mr. Stanley Wilson, Town Clerk, Town Hall, Leigh, Lancashire, on or before Twelve o'clock noon on Saturday, the 13th day of May next.

The Corporation do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to divide any Tender.

JAMES GIBSON,
Engineer and Manager.

Gas and Water Offices,
Leigh, April 25, 1905.

COAL.

THE Ballina Gas Company invite TENDERS for about 800 Tons of best Durham, Yorkshire, Lancashire, or Scotch GAS COAL or NUTS. Quantity of Gas with illuminating power will be considered. C.i.f. and f.o.b. prices must be given.

Further Particulars from J. J. REID, Ballina, Co. MAYO.

SOUTH STAFFORDSHIRE WATER-WORKS COMPANY.

TENDER FOR ENGINE SLACK.

THE Company are prepared to receive TENDERS for the supply of ENGINE SLACK, at their various Pumping-Stations, for Twelve Months from the 1st of July, 1905.

Forms of Tender, giving Particulars as to the quantity of Coal to be delivered at the various Stations, can be obtained on application to me.

Tenders, made out on the Forms provided, and endorsed "Tenders for Slack," must reach me at latest by Twelve noon on Monday, the 15th of May, 1905.

H. ASHTON HILL, M.Inst.C.E.,
Engineer.

Paradise Street, Birmingham.

STAMFORD AND ST. MARTINS (STAMFORD BARON) GASLIGHT AND COKE COMPANY.

THE Directors of the above Company invite TENDERS for the supply of 1000, 2000, 3000, or 4000 Tons of screened GAS COAL, and 100 Tons of good coking CANNEL. Quotations for own waggons, also in colliery waggons, f.o r. at Stamford Midland or Great Northern Station as required, for the Year ending June 30, 1906.

Sealed Tenders, endorsed "Tender for Gas Coal," to be delivered at the Gas Office not later than Wednesday, May 17, 1905, addressed to the Chairman.

The Directors do not bind themselves to accept the lowest or any Tender.

No Tender Forms supplied.

H. GREEN,
Secretary.

Gas-Works, Stamford,
April 27, 1905.

PURIFIERS.

THE Gas Committee of the Coventry Corporation invite TENDERS for the supply and erection, at their Foleshill Works, of Six PURIFIERS, each 30 ft. by 25 ft. by 6 ft. deep, together with Valves and Connections for the same.

Drawings and Specification, together with Schedule of Quantities and Form of Tender, may be obtained on application to the undersigned, and on payment of 30s. (which will not be returned).

The Committee do not bind themselves to accept the lowest or any Tender.

Tenders must be delivered, sealed, to the Chairman of the Gas Committee, Gas-Works, Coventry, not later than the first post on Monday, the 15th day of May, 1905, endorsed "Tender for Purifiers."

FLETCHER W. STEVENSON,
Engineer and General Manager.

Gas-Works, Coventry,
April 28, 1905.

TO ELECTRICAL AND MECHANICAL ENGINEERS.

THE Paisley Gas Corporation invite TENDERS for the following PLANT—

Contract 5.—Electric-Power Generating Plant, consisting of Gas-Engines and Dynamos.
Contract 6. — Elevated Electric Coke-Conveyors, Electric Screening Plant, Coke-Storage Hoppers, &c.

Particulars may be had on application to the Subscriber, and Drawings inspected at his Office after Tuesday, May 2.

Tenders to be lodged with Francis Martin, Esq., Town Clerk, Paisley, on or before the 13th of May, 1905, marked "Tender for Electric Power Generators" and "Electric Conveyors," respectively.

The Gas Corporation will not be bound to accept the lowest or any Tender.

GEO. R. HISLOP,
Engineer and Manager.

Paisley Gas-Works,
April 26, 1905.

BOROUGH OF PORTSMOUTH WATER-WORKS COMPANY.

NOTICE OF HALF-YEARLY MEETING.

NOTICE is Hereby Given, that the next ORDINARY HALF-YEARLY GENERAL MEETING of the Shareholders of this Company will be held at the Company's Offices, Commercial Road, Portsmouth, on Thursday, the 25th day of May, 1905, at Three o'clock in the Afternoon, on the following Business:—

To receive the Accounts and Balance-Sheets to the 31st of March last, and the Directors' Report.
To declare Dividends.
To elect Directors and Auditor in the place of those retiring by rotation.
Notice of Motion by E. H. Cooper, Esq.—
"That, having regard to the favourable statistics of the Company, and in view of the growth of the Undertaking and the very responsible duties which devolve upon the Board of Directors, and in consideration of their valuable services and successful administration whereby the full statutory Dividends have been paid for the past Twenty Six Years on all classes of Shares, the Directors' remuneration be increased to 1250 Guineas annually, free of Income-Tax, as and from the 31st of March last."
And for the transaction of the other Ordinary Business of the Company.

The REGISTER OF TRANSFERS WILL BE CLOSED from the 12th day of May, 1905, to the 25th day of May, 1905, both days inclusive.

Dated the 27th day of April, 1905.

By Order of the Board of Directors,
J. L. WILKINSON,
cretary to the Company.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

FELIXSTOWE GAS LIGHT COMPANY.

NEW ISSUE OF £5000 ADDITIONAL ORDINARY STOCK, AND £1000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 16, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

LOWESTOFT WATER AND GAS COMPANY.

NEW ISSUE OF 400 ADDITIONAL ORDINARY £10 SHARES,

Ranking for a Maximum Dividend of 7 per cent., previous Issues of similar Shares now receiving 5½ per cent.; also

£1000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 16, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY.

NEW ISSUE OF £15,000 ORDINARY "C" STOCK.

Ranking for a Standard Dividend of 3½ per cent. subject to the Sliding-Scale; the last Dividend on the Company's existing "C" Stock having been at the rate of £5 8s. 6d. per cent. per Annum.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 16, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

GAS AND WATER ORDINARY STOCKS AND SHARES

IN THE

SOUTHEND WATER-WORKS COMPANY.
CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY.
WOKINGHAM DISTRICT WATER COMPANY, LIMITED,

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 16, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

ILFORD GAS COMPANY.

NEW ISSUE OF £10,000 ORDINARY "C" STOCK, AND £5000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 23, at Two o'clock in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

Seventh Sale, Water Order, 1902.

BOROUGH OF PORTSMOUTH WATER-WORKS COMPANY.

IMPORTANT SALE OF NEW ISSUE OF SHARES

IN THIS OLD-ESTABLISHED AND GOOD DIVIDEND PAYING COMPANY.

HALL, PAIN, and GOLDSMITH beg to announce that they are favoured with instructions from the Directors of the above-named Company to SELL BY PUBLIC AUCTION, at their Estate Sale Rooms, 57, Commercial Road, Portsmouth, on Thursday, May 18, 1905, at Seven o'clock in the evening—(in convenient Lots),

The Seventh portion of the New Issue authorized under "The Borough of Portsmouth Water Order, 1902," consisting of

2000 SHARES OF £5 EACH

(fully paid), forming part of the New Ordinary Capital authorized under such Order.

The Auctioneers desire to call the special attention of Capitalists, Investors, and others to this very favourable opportunity of securing Shares in such a thoroughly sound Local Company.

The Shares will be sold free of any charges, fees, or expenses whatever to the purchaser.

Full Particulars and Conditions of Sale may be obtained, with any further Information, from the Secretary of the Company, J. L. WILKINSON, Esq., F.C.I.S., at the Company's Offices, Commercial Road, PORTSMOUTH; or of the AUCTIONEERS, at their Offices, 57, Commercial Road, PORTSMOUTH.

National Telephone No. 401.
Municipal Telephone No. 1341.

SALE OF £3000 5 PER CENT. PREFERENCE SHARES
IN THE
BRIXHAM GAS COMPANY.

MR. F. S. DUGDALL is instructed by the Directors to SELL BY AUCTION, at the Market Hall, Brixham, Devon, on Saturday, the 13th of May, 1905, at Three o'clock precisely, in separate Lots, 300 PREFERENCE SHARES of £10 each, entitling the holders to a cumulative dividend of 5 per cent., which will be paid in priority to the dividends on the Ordinary Shares. The Standard Price of Gas is 4s. per 1000 cubic feet. The Company was established in 1838, and incorporated in 1904 by special Act of Parliament. The authorized capital is £20,000, of which £8000 remains to be issued.

The sale of Gas for 1904 was 8,903,000 cubic feet, an increase of 1,283,700 over the previous year.

The new capital is required, among other things, to pay for further Extension rendered necessary by the rapid growth of the demand for Gas in the District. It will be issued free of expense to purchasers.

Detailed Particulars of Sale, with Form of Instructions to purchase, obtainable, post free, of Messrs. SCHULTZ, COMINS, & Co., 50, CANNON STREET, E.C., or of the AUCTIONEER, Brixham, DEVON.

COUNTY BOROUGH OF OLDHAM.

THE Oldham Corporation Gas-Works Committee are prepared to receive TENDERS for the supply of about 112,000 Tons of COAL required by them during the Year ending the 30th of June, 1906.

Specifications and Forms of Tender can be obtained on application to Mr. Arthur Andrew, Gas and Water Offices, Oldham, to whom Tenders are to be sent, on or before Tuesday, the 16th of May, 1905.

J. H. HALLSWORTH,
Town Clerk.

Oldham, April, 1905.

TAR.

THE Directors of the Wakefield Gaslight Company invite TENDERS for their surplus TAR for the Year ending June 30, 1906, f.o.r. or f.o.b. at Wakefield.

Quantity, about 1700 Tons.

Sealed Tenders, addressed to the Chairman and Directors and endorsed "Tender for Tar," to be delivered not later than May 10, 1905.

Further Particulars may be obtained on application to the Engineer, and Manager, Mr. H. TOWNSEND, Gas-Works, WAKEFIELD.

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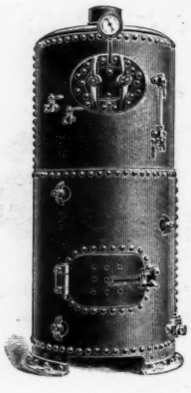

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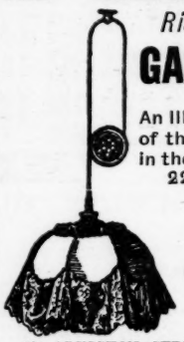

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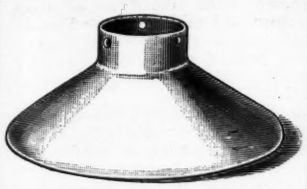

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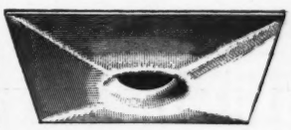

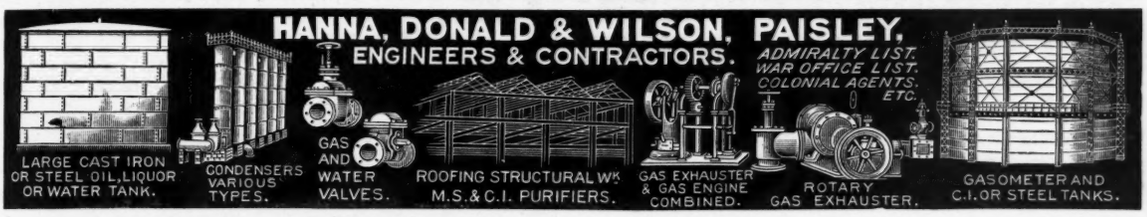
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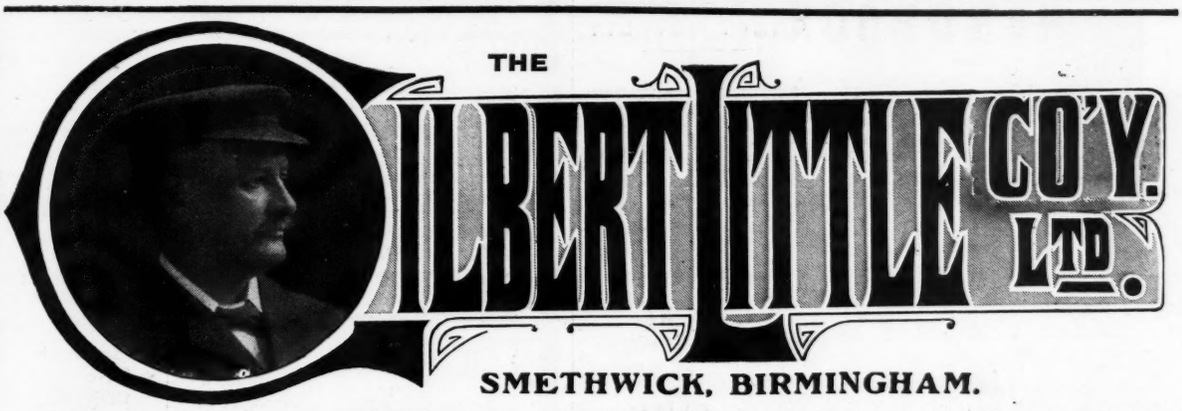

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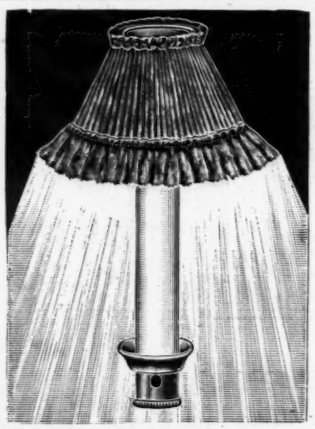
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The thread from which cotton mantles are woven is composed of about 300 separate fibres, whilst Ramie has only about 90.

Microscopical examination has proved that from the moment of lighting the cotton fibres begin to coalesce, and at 50 hours have so shrunk as to distort the mantle into a "waist" at the point where the flame is hottest. After 300 hours only a single solid filament remains—considerably smaller in diameter than the original thread—which, by reason of its lesser surface and greater density, is incapable of becoming fully incandescent. Thus, ordinary mantles **decrease** in illuminating power from the moment of lighting.

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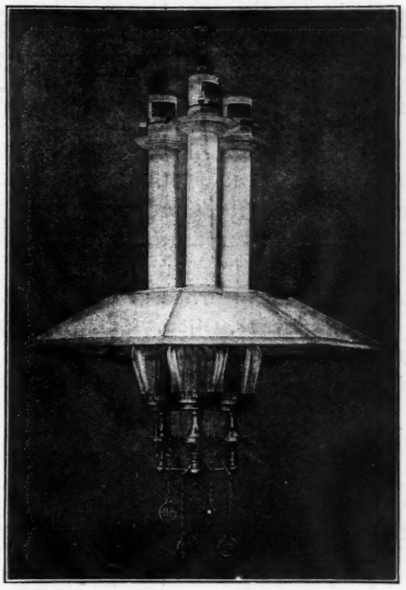

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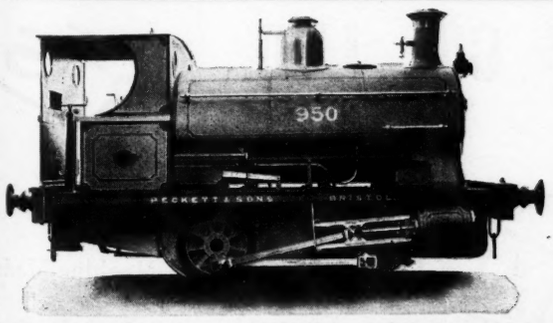

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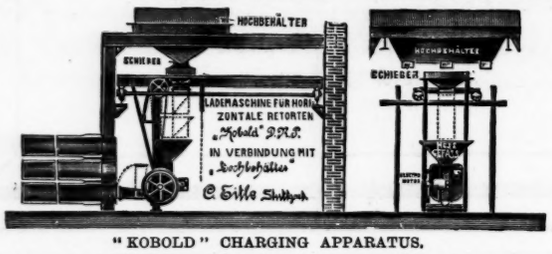

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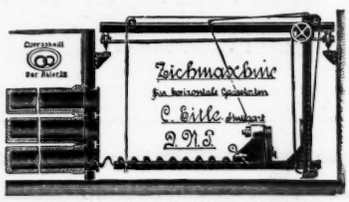

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Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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These Patent Machine-Made Retorts possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made. *Retorts carefully Packed for Export.*

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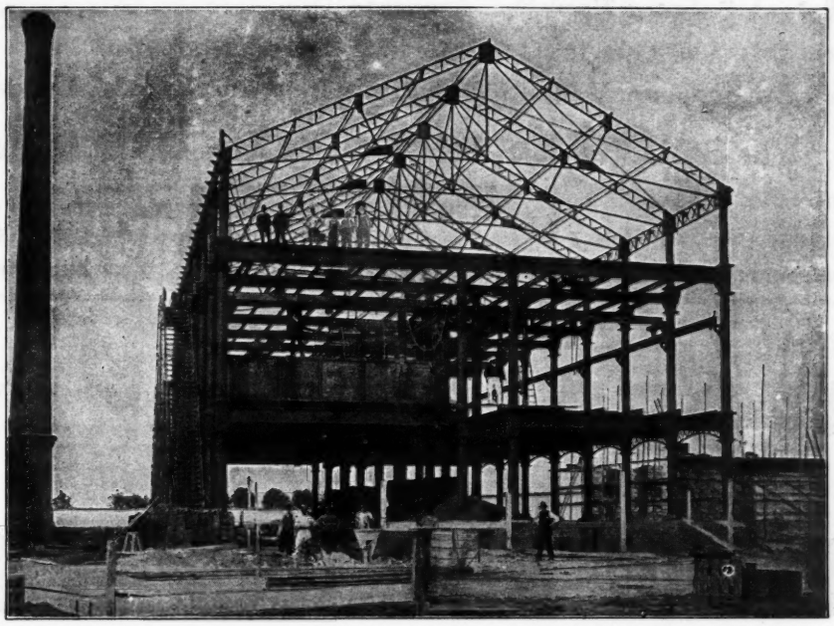

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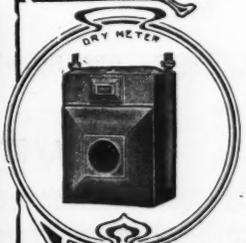

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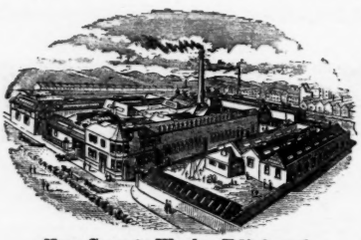

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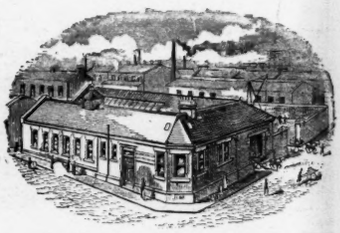

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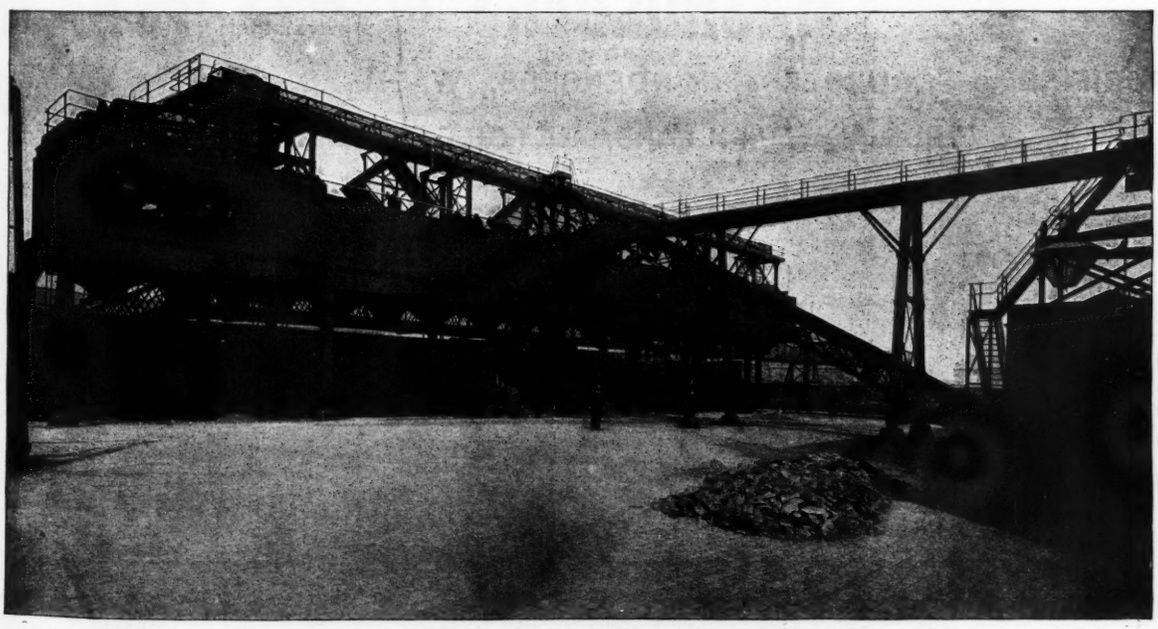

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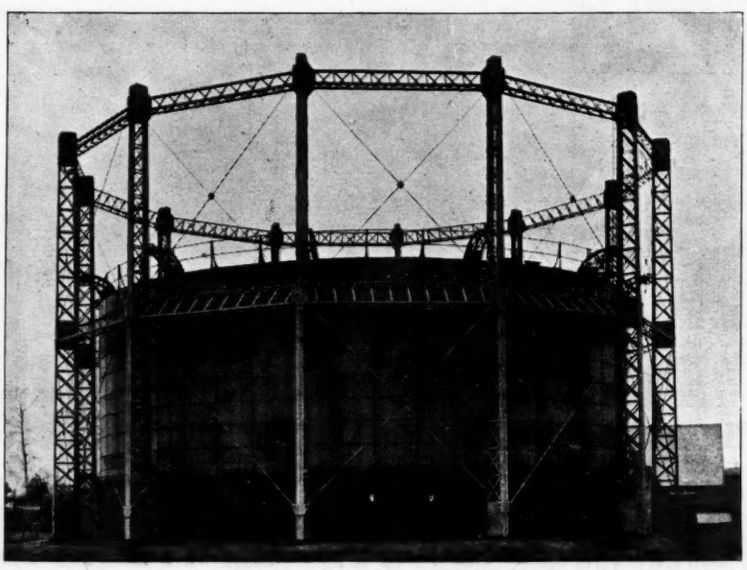

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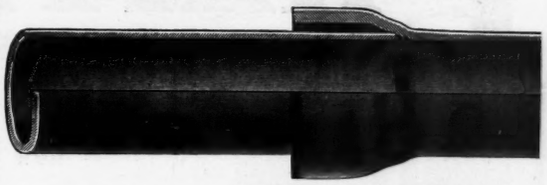

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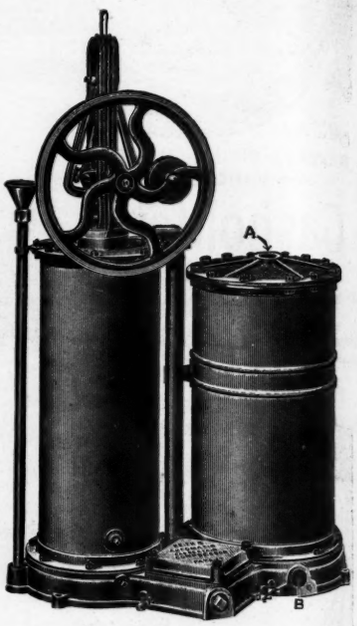

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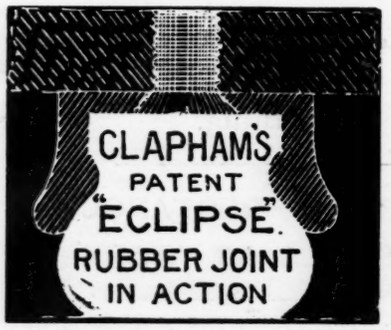

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Printed for WALTER KING by King, Sell, & Olding, Ltd.; and published by him at 11, BOLT COURT, FLEET STREET, in the CITY OF LONDON.—Tuesday, May 2, 1905.